PHILIPPINE
BUREAU
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SCIENCE

REPORTS

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SEVENTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF AGRICULTURE AND
NATURAL RESOURCES

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1918

MANILA
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SEVENTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

THE GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES,
BUREAU OF SCIENCE,
MANILA, *December 31, 1918.*

SIR: Owing to my early retirement from the Philippine Government I have the honor to submit the following abridged account of the Bureau of Science and the work performed therein from January 1, 1918, to December 31, 1918. I regret that time is not available to make this report, which will be my last for the Bureau of Science, complete and exhaustive.

In spite of the retirement of several of the scientific staff and the withdrawal of a large number of men to enter the United States National Army, the demands upon the Bureau of Science have not abated and, with the remaining personnel, the Bureau of Science has strained itself to be of the greatest service to the public. Owing to the prevalence of epidemic diseases such as smallpox, cholera, and influenza, and to the inadequate supply of scientific employees in Philippine industrial operations such as the production of sugar, coconut oil, cement, and alcohol, the Bureau of Science has been called upon to perform a very great number of analyses and examinations, to manufacture an unusually large amount of serums, to answer many technical inquiries, and to supply professional men temporarily or to give technical advice and supervision on the ground. Requests for information have been carefully replied to in writing on the following large number of all manner of subjects, in some instances of which a single subject represents requests from and replies to a large number of different individuals:

The kind of land most suited for fish ponds for bañgos;
The manufacture of tiles or vitrified brick for lining salt crystallizing vats;
The methods of varnishing copper and galvanized wire screening in order to increase its durability;
The eradication and destruction of the water hyacinth and the fertilizing ingredients contained therein;

How to employ guano as a fertilizer, and the names of firms or individuals that may be interested in buying it;
The value of fish as a fertilizer;
The so-called electric and other water purifiers;
The manufacture of vinegar from fermented ripe bananas;
The preservation of tuba by pasteurization;
The potash content of the banana plant;
The extraction of potassium carbonate from vegetable ash;
The best containers for potash;
Directions for collecting soil samples;
Directions for preparing extract of tikitiki;
That the extract from maize cannot be recommended as a substitute for that obtained from tikitiki, or rice bran;
The use of tikitiki for an educational campaign among pregnant women in Cebu Province;
Wassermann blood tests;
The differentiation of human blood from that of animals, and that of individuals belonging to different races;
The Pasteur treatment for rabies;
An outbreak of rinderpest;
The assistance to be given in the preparation of solutions in connection with a study of the value of mercury in the treatment of malaria;
Cholera work in the Bureau of Science;
The collection of lepers;
The quality of various brands of cement as shown by samples submitted;
The requirement of the Insular Government for cement, and the possibilities of the manufacture of Portland cement in the Philippine Islands;
The effect of calcium chloride on Portland cement;
The use of mosquito fish;
How to eliminate mosquito breeding places;
The effect on the fish and on mosquito larvæ produced by ducks and by oil placed in fish ponds;
Ducks that are suspected of being poisoned by drinking certain water;
Drugs or poisons that will kill wild hogs without killing other animals;
The St. Ignatius bean and belladonna root;
Plants suspected of being responsible for the death of carabaos;
Philippine fuels;
The utilization of copra meal as fuel;
The producer-gas plant of the Bureau of Science;
The Bureau of Science results regarding the value of copra cake as fuel for boiler and producer-gas plants;
The use of coconut shells in a producer-gas plant;
The relative value of Borneo crude oil as a fuel as compared with various coals available on the local market or from various Philippine districts;
The analyses of the fuel oil used on the steamship *George Washington*, which ship is chartered by the United States Shipping Board;
Philippine petroleum-bearing shales;
Petroleum and asphalt possibilities in the Philippine Islands;
The meaning of petroleum, kerosene, gasoline, distillate, etc., in order to render a decision in connection with protests against the classification of these products for internal-revenue duties;

Pulverized coal and its advantages as a fuel in the Philippine Islands;
The use of pulverized coal on locomotives;
The commercial production of coal;
Analyses of coals available on the local market and from the various local fields;
Analyses of Catanduanes and other Philippine coals;
Binding materials used in briqueting of coal;
The necessary appliances for establishing a small coal-testing outfit;
The type of plant used at the Bureau of Science for supplying gas to its laboratories;
Gas generators;
The best gas for filling small balloons;
The request of the Director of the Philippine General Hospital to enlarge the present gas plant of the Bureau of Science in order to provide the hospital with the necessary gas for its supply;
The explanation of the cause of bubbling of the water in ponds;
The extermination of rats;
The treatment for trancazo;
Difficulties in the sugar industry of Laguna Province;
The possibility of producing jute in the Philippines for the manufacture of sugar bags;
New localities in the Philippine Islands for the establishment of sugar centrals;
Literature on sugar cane analysis;
Instructions for sterilizing bottles and collecting water samples for analysis;
Tests and analyses of Philippine water supplies;
The cause of the taste of certain waters;
Whether or not the water coming from the boilers of a sugar mill is injurious to the cultivation of rice;
The manufacture of salt;
The salt production of the Philippine Islands for the years 1913–1918 in response to a request from the Japanese Consul made in behalf of the Bureau of Salt Monopoly of the Japanese Government;
The manufacture of caustic soda, sodium carbonate, and bicarbonate;
The estimated cost of establishing a soda ash factory in the Philippine Islands;
The plan of the Bureau of Science lime kiln and instructions for its use;
Antimeningococcic and other serums and vaccine virus;
The composition of fresh coconut milk;
The plant known as achuete (*Bixa orellana*) from which a coloring substance is secured;
The desirability of the cultivation of the cinchona plant (quinine);
The occurrence of *Datura alba* in the Philippine Islands;
The grasses known as *Zoysia matrella*, *Zoysia japonica*, and Korean lawn grass;
The fibers of the Philippines exclusive of abacá, piña, and the other ordinary familiar ones;
Sandalwood;
Denaturants for tobacco dust that will not diminish its use as an insecticide;
The chemical properties of betel nuts;

The seeds of chico, papaya, and ylang-ylang;
The investigation of the seeds of "dudu-dudu" and "pangi;"
The tanning properties of mangrove bark;
Philippine cutch;
Tanbarks in the tanning of leather;
The tanning of crocodile hides;
Various methods for tanning hides;
The prevention of the smell in tanneries, which is due to fermentation, by adding carbolic acid to the infusion;
Rubber;
Papaya gum and the papain industry;
Different varieties of patani bean;
The indigo industry;
The manufacture of toilet preparations;
The food fishes of the Philippine Islands and their relative values;
Whether or not fishes from artificial ponds are agricultural products;
The best nets for use in water of various depths;
Methods for packing sardines;
With regard to canning, smoking, and drying sardines;
Various features of fishing;
Information with regard to the fish "tuna," the fisheries of Naujan Lake, Mindoro, and the fish and fisheries of Malampaya Sound on the west coast of Palawan;
The fisheries of various places;
The preparation of fish skin;
The disinfection of Philippine oysters;
Pearl-shell fishing;
Identification of submitted samples of dried shrimps;
Recommendations with regard to various phases of the sponge fisheries and concessions;
Colored post cards of Philippine fishes;
To the Director of the Raffles' Museum inclosing photographs with regard to the Aquarium;
Coffee blight;
Coöperation to increase the production of food;
Philippine foods and their food values;
Banana flour substitutes;
The comparative food value of rice and wheat flour;
Coconut butter;
The directions for special butter and cheese manufacture;
The method for the determination of fat in milk by the Babcock method;
The preparation of Bear brand, Swiss natural milk, and other milks for feeding babies;
The preservation, drying, or otherwise utilizing food products;
The making of eggless and milkless corn bread;
The preparation of headcheese, scrapple, and curing of ham, smoking of meat, seasoning for sausages, etc.;
The possibilities of the manufacture in the Philippine Islands of the Japanese food "kamaboko;"
The destructive distillation of Philippine woods;
The distillation of coconut shell;
Crude drugs and chemical supplies of the Philippines;

Aid in securing industrial supplies and substitutes that may be used;
A substitute for tetrazine;
The meaning of sulphuric ether so as to permit its classification under the Internal Revenue Act;
Glycerin and its compounds;
The waterproofing of cement and paper;
The fireproofing of paper;
The cause of damage to metal containers in transit;
The best and most economical pump to use in a well 13 meters deep;
Brick making;
The lightweight waterproof tiles of the Bureau of Science;
The quality and relative value of samples of rope;
Tests of the air from tanks of the steamship *Royal Arrow;*
The market price of beeswax and the merchants who buy this article;
The market price of ambergris;
The methods for sealing bottles that have previously been stoppered;
A suitable sealing wax for protecting the cork used for bottling pickles;
The removal of molds from clothing;
The inspection of apparatuses sent to the Bureau of Science for determination of their condition and usefulness;
The standardization of fire hose;
The suitability of cogon grass for the manufacture of paper, alcohol, or other products of commercial value;
Paper making and paper-making materials in the Philippines, especially the raw materials available in the Philippines for the manufacture of paper;
The paper and paper-pulp industry in the Philippine Islands;
The price of paper pulp and chemicals;
Paper-making equipment;
The alcohol industry in the tropics;
Alcohol investigation;
The solution of the difficulties had with yeast in the manufacture of alcohol;
The distillation of alcohol from coconut tuba and other palm saps;
The manufacture of alcohol from the juice of the nipa palm together with types and cost of the necessary apparatus, purity of the alcohol obtained, etc.;
The fermentation of molasses for the production of alcohol;
The yield of alcohol that can be obtained from sugar cane molasses;
The possibilities of camoting cahoy (cassava, *Manihot utilissima*) as a source of alcohol;
The utilization and the feasibility of the commercial production of sugar, alcohol, and paper from the nipa palm;
Alcohol as a fuel for internal combustion motors;
Pheasants, pigeons, and other birds of the Philippine Islands;
The purchase of supplies for mounting birds, reptiles, and other animals;
The game laws for birds and mammals;
Recommendations with regard to permits to collect specimens of birds for scientific purposes;
The nesting and other habits of various birds;
The extermination of sparrows;

The addresses of people interested in collecting insects;
With regard to collecting insects and the markets for butterflies, moths, and birds;
The identification of insects submitted;
With regard to wild bees in the Philippine Islands;
Bee culture in the Philippine Islands;
The procedure of starting silk culture in haciendas, the laws governing it, and the price and market for reeled silk and cocoons;
The forwarding of silkworm eggs;
The care of silkworms;
Anay (termite) exterminators;
Nicotine sprays for the destruction of insects;
Philippine seeds that yield oil;
Castor oil and the plant from which it is obtained;
The exaggerated claims for a lamp that will give perfect combustion for illuminating purposes when castor oil is used;
The coconut plant and its products;
Copra and the coconut oil industry;
The use of sulphur dioxide in treating coconuts;
The extraction of coconut oil on a large scale directly from the fresh meat;
The average specific gravity of coconut oil;
The method of testing copra for free fatty acid, moisture, and oil content;
The average boiling point of coconut oil;
The process of hardening oil and the relation of coconut-oil butter to oleomargarine;
A study of coconut-oil tankage;
The process for properly refining coconut oil;
Data and costs and capacity of expellers for coconut and other oils;
Data to the Governor of Guam on the establishment of a coconut-oil mill;
An expert in copra who could assist in making purchases in the field;
Methods for the refining and retorting of gold;
Mining and agricultural products of the Philippine Islands;
The occurrence and quality of sulphur in the Philippine Islands;
The sulphur deposits recently discovered in the Philippine Islands;
The iron deposits of the Philippines;
The report of the Calambayanga Island iron-ore deposit;
The possibilities of smelting the Surigao iron ore;
How to improve the crude metallurgical Angat iron operations with small outlay of capital, taking advantage of the raw materials found in the locality;
The sale of manganese ore;
The asbestos deposits of Ilocos Norte;
The value of asbestos of the quality submitted;
The asphalt deposits in Leyte;
The possibilities of the Polillo and the Cebu coal fields;
The coal-mining possibilities of the Philippine Islands;
The mineral resources of Zambales Province;
The naming of numerous minerals and rock specimens submitted;
The addresses of the larger mining companies of the Philippine Islands with a statement of the kind of mineral in which they are interested;
Laws, rules and regulations, and technical methods governing the exploitation of Philippine minerals;

The possibilities of the manufacture of various glass utensils in the Philippine Islands;
Philippine raw materials suitable for the manufacture of glass bottles;
Philippine raw products for the committee of the Council of National Defense;
Information regarding a large number of Philippine products and industries;
Information and press bulletins for economic students of the University of the Philippines;
The available material and photographic and laboratory facilities of interest to visiting scientists and various investigators;
The industrial photographs of the Bureau of Science;
The loan of cuts to illustrate various publicity and other articles;
Photographic facsimiles of signatures;
Publications furnished to the "Commission of Independence;"
The assistance the Bureau of Science can render to the Bureau of Commerce and Industry, and in forthcoming Liberty Loan and Red Cross Drives, Bureau of Education Garden Day, Philippine Islands Medical Association, courses in cement testing and library work in the University of the Philippines, visits to the Bureau of Science of the commercial geography classes of the Philippine Normal School, the physical geography class of the Manila Institute, the teachers of Assumption School, the officers of the Japanese Training Ship *Chitose*, exhibits for the Philippine National Bank in Shanghai, etc.;
Lantern slides and cinematograph films that can be used for City Schools Garden Day, "Made-in-the-Philippines Banquet of the Missouri Press Association," Council of National Defense, and for other purposes;
Verification of figures contained in "Facts about the Philippines;"
Philippine Journal of Science, press bulletins and other publications of the Bureau of Science in response to requests from Bilar, Bohol, dated January 16, 1918, and from Santa, Ilocos Sur, dated May 2, 1918, respectively, for "particular information on the following: coal, gold or other minerals, birds, fish, fish-farms, names of plants, plant physiology, soap, foodstuffs, flowers from which perfumery is secured, different kinds of oil, sugar, different kinds of soils, cholera, smallpox, tuberculosis, bacteria, etc.;"
Introductions to other sources provided for those who came to the Bureau of Science for information on miscellaneous subjects;
Annual reports of the Director of the Bureau of Science;
The history, organization, and work of the Bureau of Science;
Suggestions with regard to classes of subjects and the selection of candidates for the Pacific Commercial Company scholarships for young Filipinos to secure advanced education in the United States;
Written testimony for the courts;
Bureau of Science weekly reports;
Other Bureaus that propose to do work that is already being done by the Bureau of Science;
Comments and recommendations with regard to legislation;
Etc.; etc.

In addition to the large number of written replies indicated above, there has been a vastly greater number of replies in telephone conversations and personal interviews. In spite of this information to the public, all in all, the Bureau of Science has been greatly undermanned at a time when there was need for greatly increased activity. By almost superhuman effort the amount of routine duties of the Bureau of Science has kept pace with the routine analyses and examinations, though many of the employees are overworked. There has been little time for other than routine toil, and many inquirers have not received as much assistance and consideration as it should have been within the power of the Bureau of Science to give. With the winning of the war, the readjustment of national affairs should make it possible so to build up the scientific personnel as to continue with vigor the valuable economic and technical research for which the Bureau of Science was organized and for which it has an enviable reputation.

WAR WORK

In times of peace, although few realize it, much of everyday life depends upon science. Clothing and most foodstuffs are manufactured products, health is protected by the combat of contagious and epidemic diseases, and business depends upon machinery and other articles of manufacture, all of which are the result of definite scientific attainment. However, in war time, everywhere there are inventions and rapid production, and people do realize that everything pertaining to modern warfare is intimately connected with scientific achievement. The soldiers' very maintenance, defense, and aggression depend upon science, and a nation would be utterly helpless in war as well as in peace in the absence of science and its products.

Wherever the Bureau of Science has been able to assist in war work other duties have been temporarily suspended in order that whatever assistance was desired might be given. The Bureau of Science is represented on the Council of National Defense for the Philippine Islands and its technical employees have volunteered in various services, especially the medical, chemical warfare, quartermaster, and in Siberian relief work. Large quantities of antityphoid serum, tetanus antitoxin, smallpox vaccine, typhoid triple vaccine, and limited amounts of several other bacterial vaccines have been manufactured and supplied for the Bilibid prisoners at Fort Mills, the Siberian refugees under the American Red Cross, and the Philippines Division of the United States National Army. A course in immunology and serology was given to the medical student officers of the last by the chief of the serum section. The preparation of a large amount of culture media and stains was done for the Philippines Division of the United States National Army. Professional advice has been given, and various poisonous gases have been manufactured or furnished in quantity for the United States National Army officers' gas-defense training school. Advice and assistance have been rendered to the Chemical Warfare Service in expediting and increasing the efficiency of the production of charcoal from coconut shells for shipment to the United States for use in the manufacture of gas masks, and with regard to the possible utilization of other Philippine products such as pili and lumbang shells for the production of gas-mask charcoal. The coöperation rendered by the Bureau of Science in this work can be shown better by quoting from a letter dated September 5, 1918, from Capt. W. S. Grove, procurement officer, Chemical Warfare Service, United States Army.

DR. ALVIN J. COX,
Director, Bureau of Science,
Philippine Government,
Manila.

* * * I have already had occasion to bring to the attention of the Chief of Staff, Philippine Department, the fact that the Chemical Warfare Service is enjoying your active coöperation. Your advices which are herein acknowledged are of course the best evidence of this.

Tests have been performed for the Ordnance and other branches of the Philippines Department of the United States Army with regard to war materials and new ordnance supplies of an explosive nature. Flares have been compounded for officers stationed at Fort William McKinley. Explanations of technical notes regarding new chemical compounds recently coming into use for gas offensive and defensive warfare, recommendations regarding types of timber best adapted to ship and aëroplane manufacture, and advice and data regarding increased production of castor oil or oil from other plants for lubricating motor machinery in aëroplanes have been given. By technical assistance and the performance of a large number of analyses the Bureau of Science has assisted coconut-oil producers to increase their output and speed up their shipments in order that the oil might be available in the United States as a source of glycerin and for other purposes. In order to assist the War Trade Board and others, the utilization of potash from the ashes of mangrove, copra cake, tobacco stems and waste, banana stalks, hemp waste, etc., and of sulphur deposits of Negros, Biliran Island, and other mineral resources has been investigated. Data are on hand with regard to manganese, ferrochrome, copper, and other available ores, oils, resins, tanning materials, natural dyes, substitutes for rubber, salt production, the possibilities of the manufacture of caustic soda, chlorine, etc. The Bureau of Science has coöperated with the American Library Association Library War Service. The library of the Bureau of Science has coöperated in the collection of books and magazines that were placed on every outgoing transport or sent to the Defenders Club in Manila (an organization for men in uniform), to Camp Claudio of the Philippines Division of the National Army, or to Vladivostok for distribution to the expeditionary forces in Siberia. All of the photographic work for the Philippine Council of National Defense, Fourth Liberty Loan Committee, and for the Philippine Guard was done by the Bureau of Science. A shipment of fifty monkeys to the United States Chemical Warfare Service has been collected by the Bureau of Science, and four other shipments are contemplated and arranged for. A great many of the regular lines of work of the Bureau of Science have a continued and direct bearing on the conservation and increase of food products in the Philippine Islands, the more economic utilization of local supplies, etc.

In response to a request from Dr. David Starr Jordan, chancellor of Leland Stanford Junior University, in behalf of the United States Government Committee on Foreign Affairs, the Director of the Bureau of Science has prepared the following statement on matters connected with the war. The Director's letter was dated September 15, 1918, and in full is as follows:

THE PHILIPPINES AND THE WAR

By Alvin J. Cox

Director of the Bureau of Science

The association of the Philippine Islands with the combat of German aggression and terror has in a way been their introduction to international affairs, and on account of our distance from the seat of operations there has been a great deal of serious thought rather than bursts of enthusiasm. This may be illustrated by an editorial entitled "The Fourth Liberty Loan Drive" in the Varsity News, the students' publication of the University of the Philippines (1918), September 6, Manila, from which the following is quoted:

> The call to the Philippines is unmistakably loud and clear today. Her help is needed, and badly too. It is to her interest that the Hun is vanquished. It is for her future that the world should be purged of autocrats . . .
>
> The university students should lead in an endeavor to help their mother country, the United States, build a 'golden bridge' over the Atlantic to Europe and crush Germany with its weight. Imbued with modern and democratic principles, they are the ones most called to give an example.

Those who per se are opposed to war, and the principles and methods of war, are everywhere giving their hearts and souls to this work, for their welfare and well-being are just as much involved as those of the allied countries of Europe. The Filipino people in their small country especially have a heartfelt sympathy for those who suffer in Belgium, France, and other allied countries; and 16,000 little school children in the Philippines are making little dresses and other refugee garments, bandages, slings, etc., to help alleviate the misery on the other side of the world.

The Philippine Government fully realizes that it is not large enough to expect to be entrusted with fundamental war duties but is doing its best, not only in the liberty loan campaigns but also in Red Cross and defence work, increased food production, and last but not least, in the establishment of the National Guard which is soon to be federalized.

The Red Cross chapter of the Philippines is one of the greatest forces for good. Full Filipino branches or auxiliaries have been organized to work in coöperation with the American unit and it is not unlikely that all efforts will be directed toward Siberia for the Philippines are near there. The total adult membership of the Red Cross is many times the number of Americans in the Islands and is already about fifteen per cent of the total inhabitants who voted for provincial governors at the general elections held on June 6, 1916. It will be much more as organization is extended. Besides this the Junior Red Cross has about 20,000 members in the public and private schools and dormitories in the Islands.

The organization by His Excellency, the Governor-General, on August 17, 1918, of the Council of Defense for the Philippines constituted of Americans and Filipinos working in harmony to coördinate the efforts "for the safeguarding of a loyal public opinion and for the organization of our resources for the support of the United States in the prosecution of this war" is of supreme importance. Branch councils have been constituted in each provincial capital with secondary units in the larger towns. This organization has been most useful in dispensing information as to the causes of the war and its progress, the principles being upheld by the Allied Nations, and in systematizing the work of advertising and canvassing for liberty loans, the Red Cross, and in suppressing sedition and stamping out undesirable propaganda.

The slogan of those interested in food work may be said to be: Produce as much food as possible and reduce imports from the United States to a minimum. As an example of this the number of home gardens grown by school children during the year has been increased from 50,000 to 100,000 as the result of propaganda.

A National Guard officers' training school conducted by regular army officers in accordance with the latest principles governing similar organizations in the United States has been in session since July 5, 1918, and is now about to close. The average attendance has been approximately 1,200 of whom 85 per cent are Filipinos and 15 per cent Americans. These students will be called upon to officer the new Philippine Division of 15,000 troops which is to be mustered into the Federal Service on November 1, 1918. The regular army officers in charge of this camp who have served in similar capacity in the United States have been much pleased with the progress that has been made and state that this school compares favorably with any in the States.

The Philippine Legislature has provided ₱4,000,000 for the construction of a submarine and a destroyer. The latter was launched in the United States on September 23, 1918, and was christened *José Rizal*, the name assigned to her by the Legislature. The Allied Countries should read into the naming of this ship all the devotion and patriotism of the Filipinos.

It is not the sum of money but the spirit manifested in providing for these vessels for use either in the Philippine Islands or outside of the same, and in assigning to the destroyer the name of their great hero and patriot that shows their devotion to the cause of the Allies.

The Philippine Islands desires to be as useful as possible to the United States and is prepared to do a great many things if given an opportunity. The Philippine Bureau of Science and other Insular organizations are coöperating with the Chemical Warfare Service of the United States Army in an effort to produce in the Archipelago the greatest possible amount of coconut-shell gas-mask charcoal. In 1917 the Bureau of Science published information showing the remarkable absorptive properties of coconut-shell charcoal, which is much more than that of ordinary wood charcoal. The coconut shells are crudely distilled before shipment to the United States so as to increase the available charcoal in a given tonnage. There are at present about 100,000 tons of surplus sugar, and large quantities of abacá (Manila hemp), tobacco, etc., awaiting shipment. It is only by accident, as it were, that there has been transportation for coconut oil for which there is the greatest unusual demand. The industrial resources and possibilities of the Philippines are great and everywhere there is a desire to place them at the disposal of the United States and the Allies as fast as they are needed and can be used. An offer of the best of the land in men and material things for the Allies is the attitude of the inhabitants of the Philippine Islands.

Liberty Day and Red Cross.—The Bureau of Science as a body participated in the Fourth Liberty Loan Parade. Bureau of Science employees subscribed ₱30,100 to the United States Fourth Liberty Loan bonds, which represents 210 per cent of the salaries for September.

The women of the Bureau of Science have made several hundred bandages and knitted garments for the Red Cross. Waste paper from the Bureau of Science has been sold for the benefit of Red Cross funds.

A Christmas Red Cross Drive was instituted in Manila, from December 22 to 28, in which all Bureaus of the Government were given an opportunity to participate. As a result one hundred ninety-two new memberships have been secured in the Bureau of Science, of which one hundred twelve are chapter members, and eighty are subscribing members. A number of the employees had taken out memberships prior to the drive, but most of these made additional contributions to the Christmas fund. The contributions together with the payments for membership bring the total collected among the employees of the Bureau of Science to ₱585.

REORGANIZATION OF THE PHILIPPINE JOURNAL OF SCIENCE

With the beginning of 1919 the sections of the Philippine Journal of Science will be combined, and the publication will be issued as a monthly; each number will be larger than the present bimonthly issues. The policy with regard to the character and scope of the material published will be continued. As heretofore, the Journal is intended to be the scientific organ of the Philippine Government, and will be devoted to the scientific and commercial interests of the tropics, and its aim will be to collect and publish in one place original scientific information and material relating to the Philippine Islands. Suitable articles will receive prompt publication in the Philippine Journal of Science, and specialists working on Philippine material will continue to receive hearty coöperation.

The subscription price for the entire Journal is now reduced to 5 dollars United States currency per annum. The majority of subscribers have been for all four sections. A refund of 2 dollars will be made to anyone that has forwarded a subscription for the four sections of the Journal at the old rate of 7 dollars. Any sum received as a subscription to a single section will be credited, and a bill will be rendered for the balance due at the new rate.

The Philippine Journal of Science in its new form will be sent in exchange to all periodicals and institutions with which exchange relations are in force.

The idea of a new series of the Philippine Journal of Science has received the unanimous approval of scientific workers in the Philippine Islands and many of our friends elsewhere with whom we have had opportunity to consult. It is believed that subscribers will find the Philippine Journal of Science, new series, in more convenient form for their general use.

APPRECIATION OF BUREAU OF SCIENCE PUBLICATIONS

Professor Henry B. Ward, dean of the Faculty of the Department of Zoölogy, University of Illinois, under date of April 6, 1918, writes:

> DEAR DOCTOR COX:
>
> May I express my personal congratulations to you on the Annual Report of the Bureau of Science which I have just received. You are doing a splendid work in developing the country of magnificent possibilities and in helping its people find themselves. May this be also an acknowledgment of the receipt of the copy of Philippine Journal of Science, Contents and Index from volume I to X.

N. G. Symonds of the Westinghouse Electric and Manufacturing Company, under date of October 21, 1918, writes:

> I duly received your bulletin of the Philippine Bureau of Science and your annual Report, and I have read them with very great interest. You undoubtedly are doing a great deal for the future welfare of the Islands and I am sure that your work will be appreciated.

The New York State Journal of Medicine writes:

> We wish to congratulate you upon the splendid arrangement of the Contents and Index to the Philippine Journal of Science, volume I to X. It is a valuable addition to the files of your journal and will make more readily accessible the matter contained in the volumes which it covers. We appreciate the receipt of this publication and your excellent journal which is sent to us regularly in exchange for the New York State Journal of Medicine.

The Director-in-Chief of the New York Botanical Garden in writing to the chief botanist says:

> * * * I cannot refrain from expressing the highest admiration and keenest appreciation of your continued productivity in the elaboration of the flora of the Philippine Islands. You are making botanical history at a great rate and clearing up many questions of high scientific importance.

COÖPERATION AND PUBLICITY

Besides the coöperation in war work with the Chemical Warfare Service and other military organizations that has been indicated under a former heading, the Bureau of Science has been largely consulted by, and has been of considerable service to, individuals and private concerns as well as many branches of the Government in substituting new methods of procedure and new materials for those that have been interfered with or interrupted by the war. Individuals have been saved thousands of pesos and have been grateful for an institution from which assistance could be received. The printed information contained in the Philippine Journal of Science, Mineral Resources, Press Bulletins, etc., has been in greater demand than ever before. The Director and his staff, through a large number of consultations, have been able to give much advice that does not become of record.

Coöperation has been given in purely scientific work as well as along industrial lines. The courtesy of laboratory space and equipment granted to Mr. H. A. Lee, plant pathologist of the United States Department of Agriculture, who was sent to the Philippines over a year ago to study the disease of citrus (lemons, limes, oranges, etc.), known as citrus canker, which had been accidentally introduced into the United States and which was, and still is, causing losses to the citrus industry in the southern United States, has been continued. Similar courtesy has been extended to Dr. W. H. Weston, of the same institution, who was sent to the Philippines to study a disease of corn that has not as yet appeared in the United States.

The disease is of so serious a nature that the authorities of the United States Department of Agriculture have deemed it essential to obtain a prior thorough knowledge of the disease, and definite knowledge of the life history of the fungus causing it in order that, should it be introduced into the United States, it might be intelligently controlled. Dr. Walter T. Swingle, chief of the division of crop physiology and plant breeding, United States Department of Agriculture, is another investigator who has utilized the facilities of the Bureau of Science during his stay in Manila.

Mining engineers, visiting the Islands with the object of investigating Philippine mineral resources, have been extended every courtesy by the Bureau of Science, and have availed themselves of its mineral collections and its technical reports and other publications with regard to Philippine geology. In systematic botanical work coöperation has been continued between the Bureau of Science and several institutions in neighboring countries. For the Canton Christian College a large number of identifications have been made and all collections made by Mr. Groff and Mr. Levine of that institution have been identified in the Bureau of Science. Mr. Merrill has coöperated with Dr. Brown, and with Mr. Fischer, Director of Forestry, in the preparation of a series of bulletins on minor forest products. Assistance in obtaining cultures has been given to medical organizations in various parts of the world. Industrial and other material has been sent to various investigators. As the result of such work the Bureau of Science is receiving many publications and favors that would otherwise be unobtainable.

Pictures of the Red Cross activities at the carnival were taken for illustrating the articles, to be published in the United States, of Mr. F. N. Doubleday, organizer of American Red Cross Branches in Foreign Countries and the Philippine Islands. Lantern slides and cinematograph films for various publicity purposes have been made. A collection of photographs of various natural and manufactured Philippine products and industries was sent to the Department of the Malaysia Museum, Chianan Institute, Nanking, China, in order to give the people of China a more comprehensive idea of the things produced in the Malay Archipelago and to cultivate an interest in commercial, industrial, and scenic resources of the Philippine Islands. Assistance was rendered to Mr. H. T. Cowling, cinematographer of the Burton Holmes Travelogues, in connection with securing moving-picture films of the various interests, places, and industries for exhibition in the United States, etc.

In addition to those already enumerated, the Chairman of the Committee on Industrial Exhibits of the 1918 Carnival, the Federal Shipping Agent, the Philippine Islands Medical Association, and others have expressed their keen appreciation of the effective coöperation rendered by the Bureau of Science.

MANUFACTURE OF TIKITIKI AND AUTOLYZED YEAST EXTRACTS

Under the provisions of Acts 2376, 2714, and 2744 the Bureau of Science has continued its work of preparing extract of tikitiki for the treatment of infantile beriberi. A stock has been continually kept on hand, and during the year about 500 liters of extract have been prepared, probably sufficient to treat more than 10,000 infants, as compared with 400 liters of extract in 1917, 300 in 1916, 200 in 1915, and 58 liters in 1914. Formerly 95 per cent of infants afflicted with beriberi died, but by the use of this extract the percentage has been reduced to practically nil, except where the cases are reported too late for satisfactory treatment. The greater part of the stock prepared was distributed through the Liga Nacional Filipina para la Protección de la Primera Infancia.

A certain amount of autolyzed yeast extract was prepared by the Bureau of Science for experimental work in the treatment of human beriberi, and this was used by Dr. N. M. Saleeby in cases of adult beriberi, a report of which will soon appear in the Philippine Journal of Science.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION AND IV ASAMBLEA REGIONAL DE MÉDICOS Y FARMACÉUTICOS DE FILIPINAS

The IV Asamblea Regional de Médicos y Farmacéuticos de Filipinas (Fourth Congress of Physicians and Pharmacists) was held at Manila, February 4–8, 1918, inclusive. The congress was held under the auspices of the Colegio Médico-Farmacéutico de Filipinas and the Philippine Islands Medical Association, and was a great success. Employees of the Bureau of Science contributed the following papers:

Extraction and chemical study of the juice obtained from the trunk of Acacia farnesiana Willd., aroma (sp. Filip.). By Ramon T. Feliciano.

Biochemical study of the alcoholic sap commonly known under the name of "tuba." By Francisco Agcaoili.

Notas preliminares sobre las materias colorantes vegetales de Filipinas. Por León Ma. Guerrero.

Studies on fungous infection. By Dr. H. W. Wade.

Consideraciones sobre la reacción de Wassermann; empleo del amboceptor hemolítico anti-mono. Por Dr. Carlos Monserrat.
Experimental cholera carriers. By Dr. Otto Schöbl.
Some bacteriologic phases of the cholera-carriers problem. By Dr. John A. Johnston.

The Bureau of Science exhibit.—A complete display of serums and vaccines with instructions for their use prepared by the Bureau of Science was exhibited at the IV Asamblea Regional de Médicos y Farmacéuticos held February 4–8, 1918, in the Colegio Médico Farmacéutico Building on Calle Lepanto, Manila. The assembled physicians and pharmacists were able to see and learn how to obtain antidiphtheritic, antitetanic, antiplague, antidysenteric, antimeningococcic, anticholera, antityphoid, and normal horse serums; vaccine virus, mallein, tuberculin (human and bovine), plague, cholera, typhoid, typhoid and paratyphoid A and B, paratyphoid A and B, dysentery (polyvalent), *B. coli*, *Gonococcus*, *Staphylococcus albus* and *aureus*, *Staphylococcus aureus*, *Staphylococcus albus*, *Streptococcus*, and *Streptococcus* and *Staphylococcus aureus* and *albus* vaccines; and antirabic vaccine for the Pasteur treatment. Rice bran (tikitiki), tikitiki extract in its different stages of preparation, and the finished product for prophylactic purposes and packed in ampuls for subcutaneous injection were also shown. There were displayed prepared cultures in test tubes of the commonest diseases of the Philippines, where were shown *Streptococcus*, *B. typhosus*, *B. paratyphosus* A, *B. paratyphosus* B, *Vibrio choleræ*, *B. dysenteriæ* (Shiga), *B. pestis* (Flexner), *Staphylococcus*, cultures of *B. dysenteriæ* and *B. coli* on Teague special differentiating medium. The commonest industrial and medicinal resins, and essential and vegetable oils extracted from Philippine plants were exhibited as well as some of the most important Philippine seeds.

Elemi, balao, apitong, almaciga, and copal resins find application in the varnish industry and in the making of resin soaps. The essential oils of ylang-ylang, champaca, vetiver, lemon grass, orange, cinnamon, and ginger are used in the perfume industry, and several of them are used in the manufacture of nonalcoholic beverages and fruit flavors. The most abundant vegetable oil in the Philippine Islands is that of the coconut. Other important vegetable oils are produced from the seeds of the physic nut, peanut, pili nut, lumbang, banacalag, palomaria, pitch seed (*Pittosporum*), kapok, cato, cashew, sesame, castor bean, and cotton. Other oils now little known may prove to be of commercial value. The seeds of *Datura alba,* which grows wild in the Philippines, the leaves and seeds of which are valuable as an asthma remedy, a source of atropin, and for other medicinal purposes were displayed. Chaulmoogra oil, and "antileprae" for the treatment of leprosy were also exhibited. The seeds of *Hydnocarpus,* which yield chaulmoogra oil, were also displayed.

A complete set of framed photographs of the serum stables, bleeding house, the process of obtâining blood from horses for the purpose of manufacturing serums and vaccines, the process of manufacturing some of the commonest foods made by the Chinese, rat-proof piers, sanitary disinfection, etc., as well as photographs of skin diseases, beriberi, yaws, tubercular leprosy, and of the commonest diseases of the Philippines were shown.

There were also displayed a complete bound set of the Philippine Journal of Science and other Bureau of Science publications of interest to the medical profession.

Visit to the Bureau of Science.—The members of the IV Asamblea Regional de Médicos y Farmacéuticos de Filipinas visited the Bureau of Science from 2.30 to 3.30 in the afternoon on February 4, 1918. About a hundred members were present. They were divided into groups and entertained with the following program:

BACTERIOLOGY

Dr. JOHN A. JOHNSTON, *demonstrator.*

[First floor, east of main entrance.]

1. Demonstration of characteristic motility of cholera and choleralike vibrios, showing the scintillating, darting movements of the vibrios.
2. Demonstration of the agglutination test of *Vibrio choleræ.* A small portion of the culture to be examined was suspended in normal salt solution, a drop of this placed on a cover glass and another drop of a known cholera immune serum in a dilution of 1–500 brought into contact with this drop, showing the prompt occurrence of agglutination and clumping.

FISHERIES

Mr. EDWARD H. TAYLOR, *demonstrator.*

[First floor of east wing.]

1. A display of the more important Philippine food fishes and of the poisonous fishes, including various species of "boteti," boxfish, and scorpion fish, was discussed.
2. A display of the poisonous snakes of the Islands, including the deadly olopong, or carasaen (the hooded cobra), tree vipers, etc., was discussed. A series of harmless snakes resembling the poisonous snakes was also shown, as well as the color varieties of "dahon palay."

BOTANY

Mr. E. D. **Merrill** and Dr. **Leon Ma. Guerrero**, *demonstrators.*

[Second floor of east wing.]

1. Inspection of the herbarium which is the basis of the scientific work of the Bureau of Science on all phases of economic botany in relation to forestry, agriculture, and education, and of the pharmaceutical investigations of local medicinal plants. The specimens are mounted; all original data, occurrence, abundance, size, uses, native names, etc., are recorded on the sheets. The herbarium is arranged in sequence of natural families, under each *family* the genera are arranged alphabetically; and under each *genus* the species are also arranged alphabetically. Philippine material is indicated by *white* labels on the genus covers; general foreign material by *red* labels; Chinese material by *yellow* labels; and Bornean material by *green* labels.
2. Exhibit of mounted specimens of local medicinal plants; also crude material as received from the field ready for chemical and pharmaceutical investigation.
3. Distribution of forms for recording economic data, and an explanation of their use.

ORGANIC CHEMISTRY

Messrs. A. H. **Wells** and F. **Agcaoili**, *demonstrators.*

[Second floor, west end of main building.]

1. Chemical and pharmaceutical investigation of medicinal, poisonous, and other Philippine plants. A display of alkaloids, glucosides, and sapatoxins isolated from Philippine plants and of commercial gums and glue substitutes found in Philippine plants.
2. The manufacture of Philippine food substitutes; namely, banana flour, coconut butter, flour products, salted vegetables, etc.
3. Demonstration of general food and drug inspection analyses.
4. The manufacture of tikitiki extract for prophylactic purposes. The various steps in the manufacture were shown: namely, maceration with 25 per cent alcohol; extraction at the pressing plant; concentration and recovery of alcohol by vacuum distillation; separation by precipitation of gums, albumens, resins, fats, and other impurities; and sterilization and bottling.

WATER ANALYSIS

Dr. T. **Dar Juan** and Mr. R. H. **Aguilar**, *demonstrators.*

[First floor, west end of main building.]

Demonstration of the Bureau of Science field outfit for the bacteriological and chemical examination of water. The importance of making an examination of water at the source becomes very apparent if the changes that may take place during the transportation of samples are considered. Carbon dioxide diminishes rapidly on standing, particularly if the initial concentration is high, and this changes the entire equilibrium system of bicarbonates and normal carbonates. Color, odor, and taste may also be altered. Biological examinations, to be of the greatest value, should be made immediately after the sample is taken, and for this reason unless the sample is packed on ice no biological examinations are made in the Bureau of Science on water over one day old. The field work on water analysis is very important.

SERUMS AND VACCINES

DRS. OTTO SCHÖBL, CARLOS MONSERRAT, and C. S. PAÑGANIBAN, *demonstrators.*

[Second floor, directly back of main entrance.]

1. Demonstration of the Wassermann reaction. The process was explained and the finished reaction shown.
2. Distribution of instructions in Spanish and in English giving the Pasteur treatment (hydrophobia preventive treatment).
3. Demonstration of the preparation of bacterial vaccines, toxins, etc.

[Serum room, first floor, to the rear of main entrance.]

4. Serum filtering, filling, etc., were demonstrated and the products exhibited.

[Serum stable.]

5. Injecting a horse for serum.

[New bleeding and operating room.]

6. Bleeding a horse for serum.

PHILIPPINE VETERINARY MEDICAL ASSOCIATION CONGRESS

The Philippine Veterinary Medical Association Congress was held February 5–9, 1918, in the College of Medicine and Surgery, simultaneously with the meeting of the Philippine Islands Medical Association.

PROPOSED NEW SERUM LABORATORY

The Bureau of Science serum laboratory is the only institution in the Philippine Islands where serums and vaccines can be manufactured. There is a constantly increasing local demand for antidysenteric, antimeningococcic, antitetanic, and other serum (on hand, being experimented with, or that are not manufactured owing to lack of room), as well as for vaccine virus, which demand it is impossible to meet under present conditions. In addition to the local demand for these products, there have been many calls through His Britanic Majesty's Consul in Manila and from several of the health officers of various cities on the China coast for quantities of antimeningococcic and other serums. The Bureau of Science has but a single horse devoted to the manufacture of antimeningococcic serum. A minimum of four months is required to bring an animal in fit condition to produce this particular serum. Cerebrospinal meningitis may be introduced into the Philippines, if it does not now exist here, and the Philippine Government should at once take the necessary steps to increase the production of this particular serum and to satisfy the demand for other serums. There is a profit from the sale of the excess supply not needed by the Government.

Normally the Bureau of Science has manufactured 150,000 units of vaccine virus per month, but since April, 1918, the output has been about quadrupled and still the reserve stock is very low. A contract is in effect with the Philippine Health Service for the manufacture of 300,000 units per month for 1919. Next year it will be necessary to increase the number of cattle in order to meet the demands of the Philippine Health Service and of the public. The Bureau of Science with its present equipment can greatly increase the output of serums and vaccine virus, the only limiting factor being stable room. Unfortunately, there is no available space in the screened serum laboratory stables for even a single additional horse, yet all animals used in the production of serums and virus should be thus protected. If extra cattle are taken on they will have to be kept outside the screened stables and under such conditions it will be impossible to prevent them from providing breeding places for flies and other vermin. Furthermore, it is undesirable to maintain a large number of horses and cattle in a residential district and in immediate proximity to the open wards of the Philippine General Hospital. The quarters now occupied are hemmed in on all sides and there is already inadequate paddock space, while the proximity of other activities makes it very difficult amply to safeguard against dust and unfavorable conditions, whereas absolute purity is one of the essentials in all products for human administration. The Bureau of Science should have a plant sufficiently large to yield these products in the quantity demanded, but it seems to me undesirable to increase the existing one in its present location.

A careful investigation shows that nowhere in Manila is a stable available that will fulfill all the requirements, or that can be made serviceable in less time and at less expense than would be necessary to provide grounds and adequate accommodations for a modern serum laboratory. A portion of the ground now occupied by the Bureau of Agriculture in Pandacan has long been considered as a possible site for expansion, but since animals afflicted with various infectious diseases are kept there in quarantine it is believed to be undesirable. Bureau of Science animals if infected with contagious diseases would be useless, and their transfer to a questionable area for the manufacture of biologic products destined for use in combating diseases of human beings should not be considered. Finally it was decided that the most satisfactory plan would be to use for the serum laboratory a portion of the Muntinlupa estate at Alabang now occupied by the Bureau of Agriculture. It is proposed to take over some of the stables and other buildings there and so to distribute the work with the main laboratory that there shall be no duplication of serum laboratory equipment nor increase in the current expenses, and that loss of time of technical personnel shall be avoided. Arrangements have been made whereby the necessary part of the Alabang property south of the Mangangate River is to be transferred from the Bureau of Agriculture to the Bureau of Science. The alterations required to accommodate the serum laboratory of the Bureau of Science and the expense of installing the necessary equipment will not be great, and an appropriation to cover the cost has been requested. When the premises are in readiness to receive the serum and vaccine work, this branch of the scientific work will be removed to Alabang.

PREPARATION AND FREE DISTRIBUTION OF ANTITYPHOID VACCINE

Under the provisions of Act 2743, the Bureau of Science has begun the preparation of antityphoid vaccine for free distribution. With the ₱5,000 appropriated the Bureau of Science has estimated that it can manufacture 21,000 1 cubic centimeter ampules, or doses, of typhoid and paratyphoid A and B vaccine, which is sufficient for 7,000 persons, at the rate of three doses per person. The first vaccine was ready for distribution on November 7, and to date 3,030 ampules have been prepared and are awaiting distribution by the Public Welfare Board of the Philippine Islands.

Directions for the use of the antityphoid vaccine and a self-addressed postal card on which is to be recorded the name of the person treated and a certification that the practitioner used the vaccine without charge are enclosed in each package.

As yet the public is hardly aware of the existence of this work, but when its usefulness and the number of lives that may be saved by the administration of this prophylactic are thoroughly realized, the work should greatly expand.

STANDARDIZATION OF GOVERNMENT MOTOR TRANSPORTATION.

The Government Motor Transportation Committee, composed of the Directors of the Bureaus of Public Works, Supply, and Science, appointed by Executive Order No. 1, dated January 3, 1916, by His Excellency the Governor-General, has continued to "pass upon all purchases of automobiles or other motor vehicles by the Government, with a view to standardizing the quality thereof." In view of the facts that the local agents are keeping in stock a sufficient quantity of spare parts and that the car itself possesses certain qualities and characteristics which make it best adapted for Government use, the committee has adopted the Chandler Light Weight Six as a seven-passenger motor vehicle for Government use. The committee has continued the standards of last year; namely, the Ford automobile, the Ford truck for motor trucks of one ton or less, the White for trucks of more than one ton, the Harley-Davidson motorcycle as a general purpose machine, and the Indian motorcycle as a lightweight machine. The conclusions of the Government Motor Transportation Committee continue to be sustained by other large users of motor transportation.

STANDARDIZATION OF SUPPLIES

The permanent committee known as the Committee on Standardization of Supplies appointed on March 28, 1916, by His Excellency the Governor-General, and composed of the Directors of the Bureaus of Supply, Public Works, and Science, has continued collecting data and establishing standards for the requirements of the various branches of the service wherever, in the opinion of the committee, it was advantageous. The work of the committee has been considerably handicapped on account of the facts that war conditions and the lack of transportation in many cases absolutely forbade the adoption of standards and it was necessary to take any class or quality of available material or equipment that would serve the various branches of the service. The method for assembling and disposing of dormant and serviceable stock in the various Government offices that were studied and for which a plan was put in operation last year has been particularly useful and successful in redistributing this property. As soon as trade routes and facilities have been reestablished the data on hand will enable the committee to continue the important work on standardization of supplies that has aroused considerable interest among many officials of the Government.

GEOGRAPHICAL NAMES

The year 1918 is a banner one for The Philippine Committee on Geographical Names, constituted by Executive Order No. 95, series 1903, and reorganized by Executive Order No. 53, issued by His Excellency the Governor-General on June 23, 1917, to consist of the Secretary of the Interior, chairman, and the Director of Coast Surveys, the Chief of the Executive Bureau, the Director of Education, the Director of Lands, the Director of the Bureau of Science, and the Director of Posts, members. The committee has held regular meetings on the first Wednesday of each month and several adjourned meetings for the transaction of business. An executive committee consisting of the Directors of the Bureaus of Coast and Geodetic Survey, Science, and Posts considers the spelling of geographical names submitted for action and reports its recommendations to the Philippine Committee on Geographical Names. During the year 1918, decisions with regard to 1,936 geographical names were made, as compared with 367 in 1917. This completes all the municipalities and barrios in the Philippine Islands the spellings of which have been submitted for action.

CARNIVAL EXHIBIT

Such of the subjects of scientific study and industrial investigation, and of the products of the various activities of the Bureau of Science as can be exhibited, in so far as the available space of three compartments would permit, were shown at the 1918 Philippine Carnival. The very creditable display of fishery products; mounted birds; tanned skins; linseed-oil substitutes, oils from Philippine medicinal plants, tikitiki extract, and other chemical products; serums and vaccines; coconuts and their products; products from Philippine clays; Philippine war minerals and mining; food-campaign propaganda; photographs; publications; etc., prepared by the Bureau of Science proved to be of exceptional, popular interest. A short description of the exhibit is as follows:

A display of Philippine elephant's ear and other sponges, as well as some of the most important fishes of the Philippines, and button shells and window shells were shown. Samples of canned salmon and sardines, dried fish, etc., imported into the Philippines from the United States, China, and other foreign countries together with a table giving the total value of the importation of the commonest Filipino foods were displayed in order to show the possibility of industrial development in the Philippines. The Philippine shark locally known as "pating" that was recently trapped in a fish corral near Maytubig, Pasay, was mounted and exhibited with the oil extracted by the Bureau of Science from its liver. Twelve and one-half kilograms of purified oil was displayed, which was 64 per cent of the original weight of the liver. Some of the commonest species of Philippine birds, including specimens of the Luzon calao, the Philippine oriole, the coleto, flycatchers, rails, herons, woodpeckers, shrikes, parrakeets, and various species of pigeons, all prepared and mounted by the Bureau of Science, made a very attractive feature of the exhibit. Skins and leathers of different kinds, cured, prepared, and tanned by the Bureau of Science, were also exhibited. Among these skins was one of a snake about 6 meters long. The skin was about 1 meter wide. There were also rabbit, dog, goat, calf, and other skins prepared and tanned in different ways.

The industrial chemical exhibit was limited only by space. It included various materials and pulp for making paper; lumbang bato and lumbang banucalag oils that make very good substitutes for linseed oil; a complete set of oils extracted from Philippine medicinal plants; chaulmoogra oil for the treatment of leprosy; rice bran (tikitiki); tikitiki extract in its different stages of preparation and the finished product for prophylactic purposes; tikitiki extract packed in ampuls for subcutaneous injection; coconuts and their products, including husks, fiber mats, door mats, brushes, and ropes manufactured from coconut fiber prepared by the Bureau of Science; copra meal that makes a very good fuel; copra-meal ash that is a good fertilizer; cement, bricks, tiles, pipes, etc., made by the Bureau of Science from Philippine raw materials; and several other oils and materials produced from Philippine products.

Food production and conservation were also represented in the Bureau of Science exhibit. A complete set of Bureau of Science food charts 1 to 7, giving the food value, namely the percentages of carbohydrates, proteins, fats, water, etc., of main food and sea food; meats; legumes and garden fruits; roots; fruits; vine crops; and leaf crops; which include unpolished rice, corn, crabs, and lobsters; dried fish, fresh fish (herring), salted fish (bagoong), poultry, eggs (hens'), pork, and beef; mongo (dried seeds), sitao (cowpea green pods), batao (shelled beans), winged pea (seguidilla), tomato, eggplant, and papaya (cooked green); sweet potato (camote), radish (Chinese white variety), taro (gabi), yams (ubi), and sinkamas; bananas (out of hand), jack (nanca), papaya (ripe fruit), pomelo, breadfruit (camansi), and santol; upo, patola (fruit), cucumber (Indian variety), squash, condol; sweet potato vines (young tips), pechay, squash vines (young tips), cabbage leaves, mustard, lettuce, and endive, were shown for the information of the public. There was also displayed Philippine Food Commission "food campaign" poster 1.

A complete duplicate of the set of serums and vaccines prepared by the Bureau of Science and displayed at the IV Asamblea

Regional de Médicos y Farmacéuticos, as described elsewhere, together with instructions for their use was shown. Those interested in medicinal preparations could see the various products including antirabic vaccine for the Pasteur treatment and learn how they could be obtained.

Philippine Bureau of Science charts 1 to 17, showing some of the natural resources and industrial possibilities of the Philippines concerning agriculture, marine and industrial products, mineral, etc., were framed and displayed. A set of framed photographs illustrative especially of these charts were mounted as leaves around one of the center posts of the building. Photographs of the serum stables, bleeding house, and the process for obtaining blood from horses for the purpose of manufacturing serums and vaccines were also displayed.

Bricks made from various Philippine clays and sands were exhibited, as well as very inexpensive fire- and waterproof tiles for roofing purposes. These materials are so light that they are suitable for use on bamboo framework. A house showing the method of laying the tiles was also displayed. The commonest war minerals together with a complete set of minerals from the Philippines, including asbestos; petroleum; asphaltum; coal and coke; magnesite; kaolinite; sulphur; gold, free and as telluride; platinum; copper, malachite, enargite, luzonite, chalcopyrite, azurite, cuprite, chalcocite, and metallic; lead, galena; zinc, sphalerite; iron, hematite, limonite, magnetite, pyrite; chromium, chromite; titanium, ilmenite; manganese, pysolusite, manganite, psilomelane; mercury, cinnabar; molybdenum, molybdenite; etc., were shown. As in previous years the exhibit contained a comparative statement of the gold production of the Philippines from 1907 to 1917, inclusive, which was demonstrated by bars giving the actual size and value of the gold produced by the mines of the Philippines during each of the years included. A large relief map of the Philippines was exhibited in the center of the booth.

Perhaps the most striking and popularly attractive feature of the exhibit was a mining camp which showed a mining district, and a gold and a coal mine. Several operations of mining were illustrated. The mine tunnels illustrated conditions as they exist in a real mine. Before the visitor entered these there was before him a distant panoramic vista of hills and mountains, a full view of hydraulic mining, a mill for cyaniding, and a dredge bordering on the river below. The gold mine showed a three-foot gold vein in diorite rock. A timber-lined shaft with doors hanging on hinges to admit mine cars on every level was built in the center. Besides entering the main entrance of a coal mine, the visitor was able to inspect the coal formation and the carbonaceous rocks as well as a room where coal is mined. The geologic formations and the method of timbering were truly typical of coal mines. The whole mining camp gave an accurate idea with regard to mining and mining work.

A complete bound set of the Philippine Journal of Science and other Bureau of Science publications was on display. "Industrial Resources of the Philippine Islands" folders in English and in Spanish, a list of the Bureau of Science publications, and many press bulletins and other publications on the natural resources of the Philippine Islands of interest to the public were distributed free.

PULVERIZED COAL

The Director of the Bureau of Science was absent from March 16 to August 28 on a trip to the United States, during which time he visited most of the stationary boilers having pulverized coal equipment and investigated American practices as to the utilization of powdered coal for fuel. Coal in the Philippine Islands now sells for more than fifty pesos per ton; and since its price is constantly increasing it is imperative that all possible be done to conserve the Philippine supply, especially by utilizing the lower grades that are not suitable for grate firing. A much poorer coal can be fired in the pulverized form than can be fired directly under a boiler, and a wider variety in the quality of coal so used is permissible. Many Philippine coals are not sufficiently high-grade for direct firing under boilers, but in the powdered form all grades of Philippine coal become applicable to boiler purposes. Detailed information with regard to this subject is contained in Bureau of Science Press Bulletin No. 86, Philippine Fuels by Alvin J. Cox, and Bureau of Science Press Bulletin No. 89, Pulverized Coal and Its Advantages as a Fuel in the Philippine Islands by Alvin J. Cox.

FOODS

The Director of the Bureau of Science also investigated in the home and elsewhere in the United States the canning and drying and other methods of conserving and preserving vegetables, meat, fish, and miscellaneous products, the introduction of domesticated honey-bees into the Philippine Islands, etc. The processes and the equipment and manufacture of small outfits that have been developed and are recommended for canning and drying various products received special attention.

Home canning of fish is feasible in the Philippine Islands. Thousands of tons of dried onions, potatoes, carrots, turnips, parsnips, beets, tomatoes, squash, string beans, cabbage, Brussels sprouts, rhubarb, egg plant, sweet potatoes, etc., are being shipped to France. The difficulty in conserving dried vegetables in the Philippine Islands is that they are subject to mold and insect attack unless packed in hermetically sealed containers. However, this may be somewhat overcome by storage in paraffined or oiled paper bags. Bureau of Science Press Bulletin No. 90, Peanuts as a Balanced Diet, issued November 13, 1918, has been very much in demand.

Containers.—In my annual report for the year ending December 31, 1917, it was pointed out that "In lime, salt, caustic soda, bleaching powder, and chloroform there is a group of allied industries that should be successfully operated together in the Philippine Islands and that present an excellent opportunity." It was realized that the sucess of a caustic soda plant depended rather on the development of local consumption than on its production for export; and, in addition to utilizing it in the manufacture of soap, thus increasing the consumption, efforts were made to establish a paper-pulp factory and to develop a glass industry. Owing to the high price of imported bottles, demijohns, glass jars, drinking glasses, lamp chimneys, etc., the Bureau of Science has been demonstrating during the entire year the usefulness of Philippine raw materials for the manufacture of glass and has made exceedingly satisfactory bottles for beer, aërated waters, etc. As the conserving and preserving of vegetables, meat, fish, and miscellaneous products develop, satisfactory containers will have to be provided. To demonstrate the feasibility of the manufacture locally of such containers molds were made for jars of various types and sizes, from which satisfactory containers have been made. I have shown the product to a glass expert who pronounces the experiments most satisfactory, and perfect in every respect except workmanship, which of course could not be perfect without ample equipment such as is available in regular glass factories. Further details of the results of the experiments in making glass from Philippine raw materials are described in Bureau of Science Press Bulletin No. 91.

TECHNICAL AND SCIENTIFIC EMPLOYEES

The Bureau of Science needs additional well-trained and able scientific employees in practically every line of endeavor, and should be immediately strengthened by good men in every line who could devote themselves aggressively to the big problems of Philippine industries and the development of industrial resources. The Director was commissioned to secure an organic chemist and a geologist in the United States; but, under existing conditions and the great demand elsewhere for such men, was unable to do so, in spite of the greatest effort. Now that the war is over men will be available and a great many, of the highest training and ability, should be secured for the Bureau of Science regardless of the compensation. Without such the work of the Bureau of Science will dwindle and the progress of the country be retarded. The industrial progress of the Philippine Islands during the last few years is in many ways directly traceable to the work of the Bureau of Science, and every peso that is now invested in securing excellently trained scientific employees will be amply returned in hastening industrial independence.

THE TECHNICAL EDUCATION OF FILIPINOS IN THE UNITED STATES

On September 13, 1918, I resubmitted a draft of a bill providing the sum of ₱235,000 annually for four years for the technical education of Filipinos in the United States. In my original letter of transmittal dated December 14, 1917, which was not acted upon for lack of time, I said:

> The industrial program that the Legislature has in mind will require a large number of thoroughly trained technical men. Any sum that the Legislature can afford to spend to secure qualified Filipinos in this capacity will be well invested. If two hundred thirty-five thousand pesos for each year is too much the sum may be reduced but by so much the industrial development of the Islands will be retarded; however, if a smaller amount is provided it is desirable to appropriate the largest sum that can be afforded for this preparation for industrial work. A program for training technical men in factories and technical schools is not new. In my printed annual report for the year ending December 31, 1916, I said:
>
> "I desire to renew my recommendation of last year that the Government aid in sending the more advanced Bureau of Science library assistants to the United States for further educational training, in order that we may have available a group of trained employees for carrying on library work of a high order and for teaching in the library training courses."
>
> I have on many other occasions pointed out the necessity for training Filipinos for technical work and the present industrial program of the Philippine Legislature makes this imperative. Recently many bills have been introduced and proposed that require trained men to carry out the purposes intended.
>
> There are not technical men in the Philippine Islands available for doing the work involved as proposed and it is high time that an intensive program for the preparation of trained technical men be started.

There is even more reason now for providing for the technical education of Filipinos in the United States. Industrial work is being continually encouraged by the Government and it is seriously lacking in trained technical men to carry on such work. I hope that provision may be made promptly so that Filipinos may be trained scientifically in bacteriology, serology, fisheries, entomology, drug analysis and pharmaceutical research, inorganic industrial chemistry, geology, the coal and iron industries, metallurgical processes, sugar chemistry, bee-culture work, etc., and in fuel and engineering establishments, tanneries, technological schools, factories, and other institutions.

DIVISION OF BIOLOGICAL LABORATORY

Personnel.—Dr. J. A. Johnston, the acting chief, has been absent for the greater part of the year on extended leave, having accepted a commission as captain in the Medical Reserve Corps, United States Army. Dr. H. W. Wade, who was assigned to routine laboratory work upon the departure of Doctor Johnston, was later transferred to the college of medicine and surgery, University of the Philippines, being retained in a supervisory capacity by the Bureau of Science on a part-time basis. Mr. H. L. Begley was granted leave of absence from April 15, 1918, to May 17, 1919. Mr. Knud B. Graae resigned, effective April 15, 1918, after approximately two years of efficient service. Three temporary scientific assistants have resigned and have been replaced by others. Drs. Ana V. Vazquez, Mariano Basaca, Antonio Garcia, Ildefonso Tobillo, and Benjamin D. Buñi were appointed as scientific assistants on March 18, June 1, June 10, July 16, and August 19, 1918, respectively.

Routine.—Routine examinations of water, milk, foodstuffs, blood, and sputum, for gonococci, and for plague, leprosy, cholera organisms, typhoid, and dysentery have been continued. A notable feature of this work is the number of examinations made for the Philippine Health Service in connection with the campaign for the detection of carriers of typhoid and dysentery bacilli. Cholera appeared in Manila in September and, though the outbreak did not prove extensive, it caused a great increase in the number of examinations required for purposes of diagnosis and of detection of carriers. At one time the situation seemed so formidable that Capt. John A. Johnston who was on leave was returned from the latter part of September to November by the United States Army to take immediate supervision of the examinations. The customary large number of smears for gonococci are now no longer submitted by the Philippine Health Service, as the segregation and supervision of prostitutes have been discontinued. The diagnostic work carried on during the year 1918 and for the fiscal year 1917 is given in parallel columns in the following table:

Nature of examinations.	1917	1918
Water	2,319	3,155
Milk		102
Foodstuffs		62
Blood	92	67
Culture	10	9
Widal test	366	1,550
Wassermann test	778	497
Sputum	882	887
Gonococci	16,715	13,888
Rats for plague	113,799	90,008
Leprosy	888	338
Urines		37
Fæces	116,949	149,890
Histological examinations	11	11
Rabies	3	3
Miscellaneous biological examinations	7,110	1,774

As heretofore bacteriologists have been assigned from time to time for microscopic diagnosis on leper-collecting expeditions of the Philippine Health Service, and Dr. Wade continues to serve as the Bureau of Science representative on the committee for the examination of lepers. Assistance was given to Passed Asst. Surg. L. R. Thompson, of the United States Public Health Service, and Lieut. H. G. Maul, of the United States Army, in their investigation of a case of reported poliomyelitis. A few health officers were sent by the Philippine Health Service to the Bureau of Science to take the course of laboratory instructions reported last year under the heading "Instructions for District Health Officers." Those who reported were assigned to study the Bureau of Science diagnosis folder and to a few weeks' laboratory instruction in bacteriologic analyses of waters and milk; examinations of fæces for parasites, cholera, dysentery, and typhoid; and examinations of sputum and pus. A large number of outside persons were vaccinated at the Bureau of Science during the year.

Consequent upon the discontinuance of the Government sanitary commissions the bacteriologist heretofore assigned to that work has been available for service in the Bureau of Science, where all available employees have been needed in handling the large numbers of examinations made necessary by the various epidemics. A very severe epidemic of influenza occurred between October and the present time but did not materially increase the diagnostic work of the Bureau of Science.

Research has been begun in connection with this recent severe influenza epidemic, and that on non-agglutinating cholera vibrios and pathogenic fungi has been continued. There still remains in the Philippine Islands a fertile field for medical research. The publications from this division are given under the Philippine Journal of Science, Section B, on page 55.

SECTION OF SERA AND VACCINES

The serum section has been heavily pressed by demands for various biological products, mainly on account of the outbreak of smallpox and bacillary dysentery. This increased demand had to be met by economizing stable space, and at times the animals used for the preparation of sera and vaccines were very much overcrowded. Temporary quarters were necessary for extra animals. The plan to transfer the serum section to the Government stock farm at Alabang, as indicated on page 24, if realized, will do away with the objectionable conditions that now exist, and will give room to other branches of the Bureau of Science for expansion. Besides there is an especial advantage in placing the serum laboratory in the open country where the animals can be kept under most favorable conditions, and the live stock can be promptly increased to any extent demanded by emergency, which is impossible under present conditions. The amounts and money value of the biologic products disposed of are shown in the following table:

Comparison of amount and value of sera and vaccines bottled and disposed of at the Bureau of Science in 1918 and in 1917.

Product.	Bottled.		Price.	
	1917	918	1917	1918
			Pesos.	*Pesos.*
Antitetanic serum .... units..	1,862,000	2,989,000	3,724.00	5,978.00
Antidiphtheritic serum ....do....	56,500	299,500	113.00	599.00
Antidysenteric serum ....cc..	12,037	48,060	842.59	3,364.20
Antimeningococcic serum.........do....	590	3,080	295.00	1,540.00
Normal horse serum...............do....	6,560	7,430	218.67	247.67
Gonococcus vaccine.........ampules..	2,368	2,170	1,184.00	1,085.00
Other vaccines....................do....	15,368	5,016	6,147.20	2,006.40
Vaccine virus.....................doses..	1,181,685	4,204,968	11,816.85	42,049.68
Autogenous vaccines ....treatments..	46	37	460.00	370.00
Pasteur treatment	217	249	2,170.00	2,490.00
Wassermann reaction..............tests..	331	497	3,310.00	4,970.00
Total	3,137,702	7,560,007	30,281.31	64,699.95

Besides supplying the greatly augmented quantity over the previous year of antidysenteric serum and smallpox vaccine as shown by the table, the Bureau of Science has on hand, with which to begin the new year, a fair stock of antidysenteric, antitetanic, antiplague, and other sera, as well as more than one million doses of vaccine virus in the process of preparation.

As soon as the serum stables are transferred to Alabang the number of horses will be trebled if the stock is available. It must be borne in mind that it requires from four to six months of immunization of horses before their serum is useful; but, if the work can be started promptly, there will be a considerably increased supply of the various sera for the next year.

Owing to the increase in prices of animal feed, containers, packing boxes, etc., the charges for some of the finished products are inadequate and not commensurate with the cost involved in their preparation; and, in view of the fact that there is to be a change of procedure in the preparation of biological products, a general revision of prices is planned.

SECTION OF BOTANY

Personnel.—Mr. Eugenio Fenix, for many years a most efficient assistant, was retired at the end of 1917 under the provisions of the Osmeña Act. His place was filled by the appointment of Mr. Marcelo Adduru, a graduate of the Forest School, of Los Baños, and more recently of the College of Education, University of the Philippines. Mr. Adduru has been absent as a student officer in the training camp preceding the organization of the Philippine Guard, and on the organization of that body was commissioned a captain. Dr. H. S. Yates, mycologist, was granted leave of absence and left for the United States on October 21, 1918. Mr. E. D. Merrill, chief botanist, was designated Acting Director of the Bureau of Science during the absence of the Director from March 16 to August 28, 1918.

Systematic investigations.—Botanical exploration of the Archipelago has been continued and extended by valuable collections made from the little known parts of Panay, Ilocos Norte, Rizal, and Camarines Provinces. Most of the field work has been done by Mr. Maximo Ramos. Mr. R. C. McGregor also made extensive botanical collections in Panay in connection with his zoölogical work. Short trips were made by Mr. Merrill to Laguimanoc, Tayabas Province, for the purpose of securing data regarding the mangrove vegetation, and to Mount Pinagtubo, Zambales Province.

The collections of Philippine plants have been studied and identified, and the new species described as received, those from Panay and from Ilocos Norte being noteworthy in the number of forms new to the Archipelago and to science. Since the beginning of botanical work in the Bureau of Science material has been assembled as far as possible from all parts of the Archipelago, and early in the present year Mr. Merrill began active work in the systematic enumeration of Philippine plants as a necessary preliminary to the preparation of a general flora, and the bibliographic work has been practically completed. An attempt has been made to account for all species credited to the Philippines by all authors and to record complete bibliographic references to each species and to all cited synonyms. At the present time something over 8,000 species are known from the Philippines, and the list is being extended. It is proposed to include all recorded native names of all dialects and languages, and to give the habitat, occurrence, relative abundance, and Philippine and extra-Philippine range for each species.

Dr. H. S. Yates has continued his work on Philippine fungi and has practically completed an enumeration of all known Philippine fungi with their essential synonyms. He has also carried on some work on plant diseases.

Mr. A. D. E. Elmer, temporarily employed as a teacher of botany in the Forest School, Los Baños, is engaged in the preparation of a forest flora of Mount Maquiling, utilizing the collection of the Bureau of Science in the preparation of this work.

Dr. Leon Ma. Guerrero has continued his work on the compilation of data regarding local medicinal plants. The appointment of Doctor Guerrero as one of the directors of the Census has seriously interfered with his duties in the Bureau of Science, as he must devote one-half of his time to the Census Bureau.

Extensive collections of extra-Philippine plants for the Canton Christian College, for the British North Borneo Forestry Service, for the Guam Forest Station, and a small collection from Hainan have been studied and reported upon.

Mr. Peter Nelson, of the Guam Experiment Station, who has undertaken a botanical exploration of Guam with the first ₱100 from the Robinson Memorial Fund of the New York Botanical Garden, has already submitted material amounting to about 200 numbers to the Bureau of Science. One set is retained in the Bureau of Science, one is returned to Guam, and the remainder sent to the New York Botanical Garden. A somewhat similar plan has been completed with the British North Borneo Forestry

Service. Mr. D. M. Matthews, formerly in the Philippine Bureau of Forestry, now conservator of forests for the Government of British North Borneo, has encouraged his Filipino rangers and assistants to make botanical collections whenever possible, and all material secured is sent to the Bureau of Science for study and report. A set of these materials remains at the Bureau of Science, one set is returned to Sandakan, and the remaining duplicates are distributed by the Bureau of Science on its general exchange account.

Physiology.—Dr. W. H. Brown has continued his work for the Bureau of Science on detail of one-fourth time from the University of the Philippines. His extensive work based on the vegetation of Mount Maquiling, entitled "The vegetation of Philippine Mountains; the relation of the environment to the physical types at different altitudes," has been completed.

Herbarium.—The herbarium has shown a satisfactory growth in Philippine accessions during the year. Foreign exchanges have been reduced to a minimum on account of transportation difficulties and the general inhibiting effect of war conditions. The total accessions for the year are 10,086 specimens as compared with 12,711 specimens in 1917. Of these 1,700 were received in exchange and about 1,200 from China, Hainan, Borneo, and Guam for identification. The collections from the Bureau of Forestry were the smallest ever received from this source during any one year, totalling but 338 numbers. There are now 196,205 mounted specimens in the herbarium. Announcements have been received from various institutions to the effect that shipments intended for the Bureau of Science are retained pending a return to normal conditions of shipping, so that in the end it is anticipated that the number of foreign exchanges will be normal. The largest single exchange received during the year was a consignment of 1,818 specimens of Malayan plants from the Botanical Garden of Buitenzorg, Java, smaller exchanges being received from the Botanic Garden, Singapore, and from the Botanic Garden at Sydney, New South Wales. Prof. C. F. Baker has presented the herbarium with a large number of Philippine fungi and a set of flowering plants collected by him in Singapore. Recently 42,000 duplicate botanical specimens, the accumulation of the past four years, were sent to the various institutions with which the Bureau is in exchange relations. Four hundred forty-seven mounted sheets have been loaned to specialists, 185 sheets sent to the Forestry Service, British North Borneo, and 202 sheets to the Guam Experiment Station.

Publications.—Numerous publications have been issued during the year and are enumerated under Philippine Journal of Science, Section C, on page 56.

SECTION OF FISHERIES

This section has continued as heretofore in coöperation with the other branches of the Bureau. A scientific assistant has been added, and numerous small collections of fishes have been studied and identified. A large number of inquiries with regard to various fisheries, fish ponds, etc., have been answered.

The imported black bass continue to do well in Baguio Lake, and there is a stock of spawn ready for distribution. The adults thrive but do not breed well in the lowlands, and it is believed that the temperature of the water is too high.

A supply of mosquito fish is continually kept on hand for distribution, and several lots have been distributed to those who have applied.

The ipon (the young of a small fish of the family Gobiidæ) fisheries of Abra River, which are typical of the ipon fisheries along the Luzon coast, have been studied. There are several runs annually of the young of this small fish, and they are taken in large quantities for the preparation of a fermented product known as bagoong. In spite of the very small size of the fish the catch in the Philippines is of marked economic importance, and is estimated at ₱500,000. The use of this fish for canning would be possible and the product would no doubt find a ready sale in interior towns. A paper entitled "Ipon fisheries of Abra River" will appear in the Philippine Journal of Science, No. 1, 1919.

The Bureau of Science has a collection of cobras from which it is segregating venom and is experimenting in the manufacture of anticobra serum. Formerly it was believed that the dahon palay was a very poisonous snake and was responsible for many deaths of harvest hands. For a long time it was believed that cobras were rare in the Philippines. As a result of careful study by specialists of the Bureau of Science, it has been shown that they are comparatively abundant and probably deaths reported from the bite of the dahon palay actually result from that of the cobra. The cobra normally is a very shy snake and probably promptly retreats after biting so that when a person has been bitten in a rice field and the area is surrounded, the cobra has already escaped. The dahon palay being prevalent is usually found and the biting attributed to him.

As it is now death probably always results from the bite of the cobra, and a successful serum will save many lives.

A study of frogs, lizards, and snakes in the collection of the Bureau of Science has been made during the year, and monographs thereon have been prepared or are in preparation for publication. The published articles from this section are given under the Philippine Journal of Science, Section D, on page 56.

SECTION OF ORNITHOLOGY AND TAXIDERMY

The work of the section of ornithology and taxidermy has been continued along the former lines and has diminished neither in quality nor in quantity. A large amount of additional data has been collected on the food of birds, and specimens have been added to the scientific study collection of Philippine birds. Large collections of birds, plants, and insects were made in Antique Province, and some additional information on the food of birds was collected at the same time. The birds and plants will be reported by the Bureau of Science. The insects have been sent to various specialists for identification. One paper on insects has already been received for publication. Other collecting trips were made into Bulacan and Pampanga Provinces. The important study of the food of birds, especially those that seem to damage crops, has been continued by the examination of the stomach contents in the laboratory insofar as other work permitted.

When not on collecting trips in the field, the taxidermist has been employed in mounting specimens such as birds, mammals, and fishes, and in tanning skins. This work has considerably increased during the last few years and a great deal has been done for private individuals.

SECTION OF ENTOMOLOGY

The need for the closest coöperation between bacteriologists, entomologists, and other scientists is continually manifest. For example, in the United States there are two very bad bacterial bee diseases, and scientists should work together to prevent their introduction into the Philippine Islands. The Administrative Code of 1917 (Act No. 2711), Section 1883, provides that "Silkworms, their eggs or cocoons, or the moths which produce silkworm eggs, shall not be imported into the Philippine Islands except by the Bureau of Science." Legislation similar to this is in effect with regard to bees in the Hawaiian Islands and the Territory of Hawaii has been successful in preventing the introduction of deleterious diseases into that Territory. The undersigned has recommended that similar legislation be passed for the Philippine Islands. Domestic bees have been successfully introduced from Hawaii into Guam without the introduction of any disease. If they can be successfully maintained in the Philippine Islands without the introduction of disease, it is believed that there is an excellent opportunity for their cultivation.

The Bureau of Science has continued to raise silkworms and to distribute eggs to persons prepared properly to care for them. One lot of silkworm eggs has been prepared for shipment to the California State Commission of Horticulture for experimental purposes. Attention is invited to my annual report of last year, page 43, in which this work was especially discussed.

There is a large opportunity for the development of raw silk as an export commodity in the Philippine Islands. Since the beginning of the war both the price and the demand have increased, and it will be many years before the production in France and Italy is rehabilitated even if this ever occurs. The Philippine Islands have a satisfactory climate for the production of worms and fertile fields for growing mulberries. Land that is unsuited for the profitable production of foodstuffs is generally sufficiently fertile to produce good mulberries for feeding silkworms, and worms may be grown throughout the year. Therefore it is only necessary to have the proper initiative in the Government and among the people to develop raw silk production as an extensive household industry. There should be a sericultural school in every community under either the educational or the scientific branches of the Insular Government so that young men and women who will become the actual silk producers may learn the industry from competent teachers. A system of inspection should be provided in order to assure the quality of the silk and to prevent mismanagement that can result only in failure.

CHEMICAL LABORATORY

Chemical work along the lines indicated in my former reports, and especially in that for the calendar year 1917, has been continued whenever time would permit, and some new studies have been undertaken. The assistance given the United States Army and other war work has already been mentioned under the heading "War Work." However, the time of the present restricted personnel is so occupied by routine analyses and duties that there is little time for the investigations now in various stages of completion. Field work has been stopped practically, due to lack of employees, and investigations at the present time are confined mostly to the laboratory where men devote their spare hours and perform much overtime work. Some very good Filipino analysts are being developed from graduates of the local universities, but it will be several years before any of these acquire the qualifications and maturity to handle intricate problems independently. The field of industrial chemistry is opening up in the Philippines, and the Bureau of Science must have trained industrial chemists and not merely analysts. As pointed out under the heading "Technical and Scientific Employees," high-grade chemists and chemical engineers should be available who can devote their undivided time energetically to the solution of the problems of local industries and the development of natural resources. The work of the geologist, botanist, ornithologist, entomologist, etc., is associated with many of these problems.

Owing to the number of chemists in the Bureau of Science who have volunteered for war work, or who have left the Government service, fewer results have been prepared for publication than in any previous year. However, work along industrial chemical lines in the Philippines is constantly increasing and it is believed that the Bureau of Science has been more frequently called upon for, and has given, more advice with regard to industrial problems than heretofore. Results on some of these lines of work and subjects have been, or are to be, published and the titles are given in the contents of the Philippine Journal of Science, and in the list of Philippine Bureau of Science Press Bulletins cf. p. 57.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

Personnel.—There have been a few changes in the personnel of the division. Dr. T. Dar Juan, formerly in charge of the section of analytical chemistry, was appointed chief of the division on March 16, 1918. Mr. Francisco D. Reyes, who was temporarily detailed to the Bureau of Science Iloilo sugar laboratory, was assigned to work in this division on April 1, 1918, and was placed in direct charge of the section of physical chemistry on July 1, 1918. Mr. Francisco Peña, who resigned on November 30, 1917, was reinstated on August 1, 1918. On April 16, 1918, Messrs. Rafael H. Aguilar, Ramon Abarquez, Isaias Olayao, and Francisco Villanueva were given regular appointment as assistant chemist, junior chemist, and scientific assistants, respectively, as the result of having qualified in the examination held by the Bureau of Civil Service. On November 1, 1918, Mr.

Angel S. Argüelles was placed in immediate charge of the routine analytical work of the division. Mr. Villanueva was released to enlist in the Philippine Guard on July 5, 1918, but was reinstated in the Bureau of Science on November 10, 1918.

Routine.—The routine work has been greater in variety than in former years and has occupied a large part of the time of the members of the division. The work accomplished is shown in the following general summary:

Nature of material.	Samples.
Rocks and minerals	9
Metals and alloys	51
Soils, fertilizers, cements, and clays	5,043
Road materials	3
Stone, gravel, sand, and concrete	68
Physical tests of wire, twine, textiles, steel, fiber, tar, asphalt, paper, etc	139
Water	158
Standardization of weights and measures:	
Length	72
Capacities	820
Weights	1,789
Coal analyses	33
Calorimeter determination of fuels	33
Paints, natural pigments, and varnishes	2
Crude chemicals (preparation and analysis)	119
Fire assay of gold and silver	246
Refining of precious metals	7
Miscellaneous	48

A great many of the samples mentioned in the preceding summary represent more than ordinary routine work, for it is frequently necessary that members of the division perform short investigations to enable them to pass judgment on the quality of the sample under examination.

In compliance with Executive Order No. 19 of May 24, 1918, the old method of testing Portland cement has been modified to conform with the revised specifications for Portland cement as published in Circular No. 33 of the Bureau of Standards, United States Department of Commerce and Labor, issued January 18, 1918, and known as the United States Government Specifications for Portland Cement. The new specifications discard the tensile strength test of neat cement and their enforcement in the Philippine Islands has decreased to some extent the work being performed in our cement-testing laboratory.

The refining of Philippine gold and other precious metals always has been done in the United States until it was undertaken by this division about six months ago in connection with the assaying work. In former years there were in circulation in the Philippines large quantities of American gold coin, and the melting of gold coin was an authorized general practice among local jewelers. However, with the present restrictions, gold coins are no longer available in large quantities, and local jewelers are compelled to use the gold mined in the Philippines. Gold bullion as it comes from the mine is too impure and too brittle for the manufacture of jewelry. Therefore, steps have been taken to carry on the refining of gold in the Bureau of Science in order to encourage local gold-mining enterprises and at the same time to aid both the jewelers in securing a supply of gold and the Government in preventing jewelers from melting American gold coin for jewelry purposes. The value of gold bullion and other precious metals refined in the Bureau of Science during the last six months is approximately ₱95,000.

In addition to the purely routine work, various activities that have a direct bearing on local industries or the activity of other branches of the Government, have been undertaken as follows:

Standardization of coconut shell.—This work was undertaken at the request of United States Army authorities in connection with the coconut shell "buying campaign" which was initiated by the procurement officer of the Chemical Warfare Service. Coconut shells are very bulky and the purchase of large quantities by weight was troublesome to the interested parties. In view of this fact it was thought that, by determining the average weight of several strings containing a definite number of shells of a given size, a standard weight might be fixed for each string. For practical purposes this method is accurate enough and averts the need of the many weighings required when coconut shells are bought in large quantities and in remote places.

Charcoal.—Several tons of coconut-shell charcoal have been prepared by the Bureau of Science in order to assist the Chemical Warfare Service in setting a standard as to the percentage of volatile combustible matter that charcoal purchased by the United States Government should be allowed to contain. This is further discussed on page 10 under the heading "War Work".

Experiments on the comparative gas-absorption power of charcoal prepared from coconut shell, mangcono wood, and lumbang and pili shells have been made with a view to determining the efficiency of charcoals prepared from materials available in commercial quantities in the Philippine Islands. Preliminary results indicate that pili nut shell charcoal has a higher bromineabsorption power than that made from coconut shell, mangcono wood, or lumbang nut shell.

Instruction in cement testing.—As in previous years Mr. Albert E. W. King, has been assigned to give the course in the cement-testing laboratory to the civil engineering students of the University of the Philippines.

INVESTIGATION

Limestone burning.—The study of the efficiency of different fuels available in the Philippines for lime making will soon be completed. Large-scale experiments prove that wood and coconut shells are cheaper and more convenient fuels for limestone burning than coal. With the price of coal at ₱55 per metric ton, wood at ₱24.44, and coconut shell at ₱10, the cost of the fuel to make one metric ton of lime would be: for coal, ₱27.70; for wood, ₱18.60; and for coconut shell, ₱8.50. At these prices it is hoped that modern lime burning on a commercial scale will give a good margin of profit.

During the coconut shell buying campaign initiated a few months ago by the Chemical Warfare Service of the United States Army, a market which did not before exist was created for coconut shell. The demand for coconut shell was met at very reasonable prices, often as low as ₱8 per metric ton delivered to the nearest railroad station. After the war was over the demand for the coconut shell came to an end also. However, it is believed that the results obtained by the Bureau of Science with coconut shell in limestone burning will give new incentive to those who have been supplying the Army with this fuel.

Glass making.—The present war has brought about a shortage in bottles and other ordinary glass articles, as well as an increase in their price. The results obtained by the Bureau of Science in its glass-making experiments are very encouraging and prove that bottles, demijohns, jars, etc., of good quality can be manufactured from Philippine materials. A press bulletin as to the suitability of local materials for the manufacture of glass and soda ash has been prepared for the information of parties interested in these industries and for the public in general. This subject is further discussed under "Foods" on page 30.

Furnace blueprints.—The Bureau of Science has received many inquiries with regard to the type of furnaces used in glass making and in brick burning. To answer these the Bureau has prepared a design for a glass furnace with a capacity of approximately 5,000 bottles, and a design for a brick furnace with a capacity of 5,000 bricks. There has been a demand for the plan of the Bureau of Science limekiln. Blueprints of these designs can be obtained from the Bureau of Science at ₱0.50 per copy.

Lumbang oils.—Studies made by the Bureau of Science on lumbang oils have created a great deal of interest among oil manufacturers. Several local concerns who heretofore have devoted their efforts exclusively to the manufacture of coconut oil are now turning their attention to the manufacture of lumbang oils in commercial quantities. In order to answer the many queries received with regard to this subject and specially with regard to the extraction of the oil on a commercial scale, as an adjunct to the paint and varnish investigation, further work has been carried on and a paper on the industrial extraction of lumbang oils will soon be ready for publication.

The metallurgy of Philippine iron ores.—The importation of pig iron into the Philippine Islands is increasing considerably from year to year, and the Bureau of Science has made some investigations in order to ascertain the conditions peculiar to the smelting of iron ores found in the Philippines with the object of stimulating the production of good-grade pig iron castings. The results of preliminary experiments have been very encouraging and it is hoped that, if this work be properly extended, it may serve as a working basis when a more modern smelter is established in the Philippines. At the request of the Honorable the Secretary of Agriculture and Natural Resources a memorandum has been prepared as to the possibilities for developing the great Surigao iron-ore deposit.

Philippine ropes and cordage.—A study of the mechanical properties of Philippine coir and coir cordage as compared with abacá and a study of the mechanical properties of Philippine bast-fiber ropes have been completed and manuscripts on these subjects prepared. It is hoped that they will help to encourage the cultivation and manufacture of fibers such as *Abroma augusta* (annabó, nabu, nabo, suyapu), *Gnetum* species (caliat, candiat), and *Corchorus olitorius* (saluyut, jote), that have sufficient strength and durability for cordage purposes.

Clay products.—With the resignation of Mr. Tecson and the release of Mr. Villanueva to join the Philippine Guard the work on clay products had to be stopped temporarily. At present the ceramic laboratory is engaged in the manufacture of special firebrick to be used in a boiler furnace of the Bureau of Science. This work is being done in the Bureau with Philippine materials, because no bricks of the shape and quality desired can be obtained in the local market.

Commercial fertilizers.—No systematic investigation has been made heretofore to determine the efficiency of commercial fertilizers sold in the Philippines. This is work of great importance because it may result in the promulgation of a law which will protect the farmer against the low-grade fertilizers commonly sold in the local market at exorbitant prices.

Chemical by-products.—Investigations made by the Bureau of Science have served private enterprises as the working bases in the development of industries formerly unknown in the Philippines. The Philippine By-products Company has recently been established to exploit especially the recovery of potash from the ash of tobacco waste, copra cake, and other plant wastes. Other by-products which up to the present time are largely being wasted but if properly developed may become a source of income to the Islands are glycerin, molasses, bromine, iodine, tannin, bleaching powder, chloroform, acetic acid and its derivatives, wood alcohol, and several other products derived from the dry distillation of woods, etc.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—The division has been very short-handed since the resignations of last year for it has been impossible to get additional qualified chemists. Mr. A. H. Wells continues as chief of the division. On November 1, 1918, Mr. Francisco Agcaoili was designated chief of the section of food analysis. Mr. Ramon Feliciano resigned effective September 22, 1918, and left for the United States to continue his chemical studies. Mr. Wenceslao Salvador was appointed apprentice chemist and began his duties on July 16, 1918. Mr. H. J. Carsten was appointed in charge of the Bureau of Science Iloilo sugar laboratory on September 3, 1918. In December Dr. Granville A. Perkins was appointed in the United States organic chemist in the Bureau of Science and will sail for Manila as soon as practicable. In spite of the fewness of employees there has been no congestion of work. This does not reflect a full personnel nor completed possibilities for further expansion, but rather continuous drive, a restriction of tasks, and the loyalty of the personnel in their application to assigned duties and their willingness to put in long hours of overtime at hard conscientious work.

Activities.—The work of the division is very important and requires the services of men with experience, particularly those who have specialized in food analysis and drug analysis in addition to organic chemistry. The routine analytical work comprises official and private analyses of oils, fats and waxes, all classes of foodstuffs both imported and domestic, native drugs and proprietary medicines, opium assays, toxicological examinations, and other work of a chemico-legal nature. During the year over 2,000 complex chemical analyses of all classes have been performed. A storeroom stock of about 50 liters of Bureau of Science book and label varnish has been prepared to satisfy the demand. The work has been segregated and apportioned among the various members of the staff with due regard to their ability and effectiveness in special lines. The demand by the medical profession for clinical analyses has been somewhat excessive and shows that medical men attach increasing importance to careful chemical analyses of blood, urines, and fæces.

As already indicated under the heading "War Work" the United States Army has been aided in every way possible with both chemical materials and advice regarding whatever problems have been presented.

Aid has been given to the insular oil industries not only by performing their chemical analyses, but by personal visits to the factories and by investigations of their minor problems. This work has furnished them a basis for the shipment of oils, and has given them accurate data for the calculations of production and storage. There has been a demand for copies of the Bureau of Science publications on coconut oil. Copra produced in the Philippines by the sulphur dioxide method has received most favorable comment from the mill men. Mr. H. E. Catt, manager of the Orangerie Bay Government Plantation in Papua, states that the method will be thoroughly and comprehensively employed on their large plantations. Much work has been done among the distilleries in aiding them to gain a greater production of alcohol from molasses, which until recently had been largely a waste product in the Philippines.

The Iloilo sugar laboratory has been reëquipped and opened for continuous service to the sugar industry in the Philippines. Mr. H. J. Carsten, the chemist in charge, is a person of training and wide experience in sugar-house methods and factory control. Although he has been in the service but a few months, the work being done by him in Negros is highly commended.

The plant for the manufacture of extract of tikitiki has been segregated in a well-equipped room and is now operating under perfect conditions. Samples of the extract kept for over a year show no signs of deterioration. All demands for the extract have been filled promptly, and the product has given the greatest satisfaction. The number of bottles of tikitiki extract sold or delivered during the year is as follows:

	Bottles.
To La Liga Nacional Filipina para la Protección de la Primera Infancia	7,808
To the general public	729
Total	8,537

Work of an investigational nature has been seriously curtailed by the lack of personnel as well as by the increased demands made for outside consultation work and by the greater number of more complex time-consuming analyses that have been performed. Nevertheless, the work on the chemical investigation of medicinal plants has been continued and valuable results have been achieved. Methods and standards have been formulated for the preparation of the main Philippine prepared foods, and such standards have been accepted by the Board of Food and Drug Inspection. Standards have been made for bagoong, patis, tinto dulce, tinto seco, and other foods and beverages.

The supply of chemicals and reagents necessary for the operation of the organic division has been curtailed by war conditions, but has been so conserved as to meet the needs for the proper performance of analyses. When certain reagents have been expended, new methods of proven accuracy have been employed, thus opening up a new reserve stock of chemicals. All wastes and by-products have been conserved and the possible products of value recovered from them, either by direct refining or by synthesis. There is need for research work in establishing careful chemical control of various developing industries in the Philippines, such as the coconut-oil and lumbang-oil industries; the development of the castor-oil industry; the production of plant extracts known to be of commercial or medicinal value; the investigation of new insecticides and fertilizers of an organic nature; the promotion of the tanning and leather industry; the furtherance of the paper-pulp industry; more recent chemical survey and comprehensive study of the crude petroleums, asphalts, bitumens, etc., found in the Islands; the advancement of the canning industry for the conservation of fruits, choice vegetables, and fish; the advancement of the paste industry for the manufacture of spaghetti, macaroni, noodles, and various kinds of wafers; the development of margarine works and other plants for substitutes of reserve value and cheap cost. Every industry in the Philippines should receive close observation by the Bureau of Science and should be guided and encouraged to develop along a scientific course.

DIVISION OF MINES

Owing to war conditions it has been impossible to secure geologists for the Bureau of Science. Two of the major positions have been vacant throughout the entire year. Mr. Victoriano Elicaño has been left alone in the performance of the routine work during the greater part of the year. Mr. L. A. Faustino, Bachelor of Engineering from Ohio State University, was appointed junior assayer in January, 1918. Mr. Faustino joined the Philippine Guard on July 9, 1918, and is still on duty there. While on duty with the Bureau of Science he not only performed the assay work but also assisted in the general routine work and especially in the compilation of statistical data with regard to the mineral resources. During his absence the assay work was performed by employees of the division of general, inorganic, and physical chemistry, and the results are included in the report on that division in connection with the refining of gold and other precious metals.

The number of inquiries that have come during the year from the general public has been very large, and several hundreds have been answered. Consultations with mining prospectors and operators, determination of mineral and rock specimens, and the examination of rocks of various classes have taken a great deal of time.

The cuttings from 163 artesian wells were examined during the year. The examinations could be made only when other work was not pressing.

The customary work in preparing maps and drawings for publication in the Philippine Journal of Science has been carried on by Mr. P. Moskaira and his assistant.

Because of the limited personnel it has been impossible to keep up the usual quota of field work. In addition to the routine demands, a reconnoissance trip was made to the coal properties of Mr. Esteban de la Rama at Escalante, Occidental Negros. No development work had ever been done there and continuous heavy rains made exploratory excavations impossible so that the work was confined to locating and tracing the outcrops of the coal seams. In April and May a geologic reconnoissance of Lubang and the neighboring islands was carried on for the purpose of determining the extent and quality of quartzose sand deposits reported to have been found in those islands. In response to a request from the United States War Trade Board, regarding sulphur deposits in the Philippine Islands, a general reconnoissance of the sulphur deposits at Silay, Occidental Negros, and southern Camiguin Island, Misamis, was made during the months of August and September. Unfortunately, the deposits are of small extent and of no great commercial value. In October various coal-mine properties which are being developed and operated on Cebu Island were visited. Additional information was gathered with regard to raw cement materials found in the vicinity of Naga, Cebu. Several smaller investigations were made.

In spite of war conditions which have greatly affected the cost of transportation of mining machinery, fuel, and chemicals used in the mining industry, Philippine mining has made progress during the year. Coal-mining activities have been revived. The Philippine National Coal Company anticipates a large output in the near future. Prospecting of several of the Philippine oil fields has been resumed, and Mr. Anderson is continuing the development of his oil and asphalt properties in Leyte. The Colorado Gold Mining Company, of Masbâte, stopped operations for a few months in order to repair and remodel its mill. The Syndicate Mining Company mill at Aroroy, Masbate, has been enlarged. Severe storms caused the sinking of some of the dredges, which considerably curtailed the gold production. New and promising galena veins have been reported from Marinduque, and it is understood they are being developed. Prospecting and testing of new placer grounds in Mindanao also have been reported. Considerable interest has been shown in the copper deposits in Mancayan and Suyoc, and testing of the placer ground along the Abra River Valley is being carried on. The Benguet Consolidated Mining Company, in the Mountain Province, has shown increased gold production.

In December I prepared, for publication in the Statesman's Year Book, a statement relating to the development of the mineral resources of the Philippines as follows:

STATEMENT RELATIVE TO MINERAL RESOURCES OF THE PHILIPPINE ISLANDS

Gold is found in almost all the larger islands and continues to be the most important of the mineral products. Masbate and Ambos Camarines Provinces and Mountain Province are still the only gold-producing districts in the Archipelago. Prospecting and development work are being done in Mindanao and Mindoro Islands. The production of gold for the calendar year 1917 was valued at 1,408,319 dollars, as compared with 868,362 dollars for 1913, 1,174,633 dollars for 1914, 1,316,764 dollars for 1915, and 1,505,877 dollars for 1916. Development is being continued on some of the known copper, manganese and lead deposits. Iron is produced in small quantities from the Bulacan deposits, but the Surigao and Calambayanga deposits are still undeveloped. It is anticipated that these will be exploited soon. The coal fields of Cebu, Mindanao, and Albay are being developed. A production of 3,200 tons of coal was reported in 1917. This production is expected greatly to increase. The deposits of asphaltic materials and oil-bearing shales in Leyte are now being developed. Exploration has been resumed in the Tayabas oil fields. A few tons of sulphur have been produced from the small deposits of Silay, Occidental Negros. The local consumption of Portland cement manufactured by the Rizal Cement Company is increasing every year. The total value of minerals in 1913 was 1,972,290 dollars, in 1914 was 2,301,695 dollars, in 1915 was 2,433,793 dollars, in 1916 was 2,832,130 dollars, and in 1917 was 3,002,944 dollars.

The annual bulletin Mineral Resources of the Philippine Islands has not been published for 1917 for several reasons, especially owing to (1) the failure of operators to supply the customary statistical data of the mineral production, and (2) the lack of personnel to acquaint itself with regard to the progress of the different mining activities, and to visit the various mining districts and report a general review of operations there, all of which constitute important items for the publication.

The statistical information on mineral production is still incomplete, but the most accurate approximate figures are as follows:

Estimated statistics of mineral production in the Philippine Islands in 1917.

[Approximations only.]

		Quantity.	Value.
			Pesos.
Metallic.			
Iron	metric tons	50	18,000.00
Silver (alloyed with gold)	fine grams	125,000	6,250.00
Gold	do	2,119,000	2,816,638.37
Value of metallic			2,840,888.37
Nonmetallic.			
Coal	metric tons	3,200	80,000.00
Clay products	do		900,000.00
Lime	do	14,000	270,000.00
Sand and gravel	cu. m	725,000	700,000.00
Stone	do	230,000	350,000.00
Salt	metric tons	26,000	780,000.00
Mineral waters	liters	3,350,000	85,000.00
Value of nonmetallic			3,165,000.00
Grand total			6,005,888.37

The past year has been marked by much interest in legislation concerning mining. The coal-mining law is now operative, and other bills concerning different phases of mining industries are pending in the Legislature. In view of the difficulties experienced in compiling statistical data of the different mineral products of the Philippine Islands it is believed that a law, requiring all mine operators or mine owners or prospectors to report to the Bureau of Science their yearly output and to send a copy of their annual and other reports, should be adopted.

The responsibility of this branch of the Bureau of Science is entirely too great for the personnel available. In order to be acquainted with mining operations and to undertake the necessary geologic work the Bureau of Science should have at least two geologists, a mining engineer, and a metallurgist, besides the necessary minor employees. Furthermore other coal mines will no doubt begin operation soon and, according to the law, the Bureau of Science is responsible for the proper inspection of such operations. Also, the oil and coal fields of Mindanao should receive detailed study with regard to their economic value. The personnel should be increased with these growing activities, and the reported valuable mineral resources such as tin in Palawan, and cinnabar in Palawan or Buruanga Island, should be investigated.

LIBRARY

Three of the older student library apprentices have completed their college courses and are no longer on duty. One was appointed to a civil service position as junior librarian and is now absent on leave at the University of Wisconsin, in the United States, having been designated under the provisions of Act No. 2746 to specialize in bibliography and library science. The two others have resigned. One passed the first-grade civil service examination and now holds a responsible position in the legislative reference division of the Philippine Library and Museum. Other apprentices are being trained to fill the vacant positions, and the routine work has been continued. Miss Margaret Upleger was appointed in the University of the Philippines on October 26, 1918, and is detailed for half time in the Bureau of Science.

None of the volumes prepared and sent for binding during the year have been completed, but all of the 2,659 volumes remaining at the bindery on December 31, 1917, were returned. A number of new volumes has been received. The distribution of duplicates has been continued. An employee from the Bureau of Printing with long experience in the binding department has given excellent service in inspecting, cleaning, fumigating, and mending books, etc. The total number of bound volumes accessioned was 3,498, making a total on December 31, 1918, of

42,218 bound volumes, 4,268 unbound volumes, and 21,121 unbound pamphlets and parts. The average circulation has continued about as last year with an increase in the use of books in the library. The record of technical work performed during 1918 is as follows:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	402	616	475	1,550
Reclassification and cataloguing	121	406		444
	523	1,022	475	1,994
Printed cards prepared and filed				1,593
Total cards filed in official catalogue				3,587

The work on arrears has been less than in previous years while considerable progress has been made on the union catalogue. The printed cards filed were for the most part continuations of series. The cuts that were reported as waiting for entry last year were prepared for use. There are now 5,374 cuts on file, of which 153 are waiting for entry and preparation for the shelves. Fifteen additional sets of the Philippine Journal of Science were prepared for binding in order to provide for the increased demand for this publication. It is hoped that the exchanges with the Philippine Journal of Science that were discontinued as the result of conservation in the United States may now be reëstablished with little serious loss to the library files.

The library has received several valuable collections from friends, and that donated by Dr. N. M. Saleeby on leaving the Philippines is an especially important contribution. The courses in library training given in the College of Liberal Arts and in the College of Medicine and Surgery of the University of the Philippines have been continued. They have taken more of the time of the librarian than rightly could be spared, and it is hoped that in the end they will do much to relieve the need for library assistants. With the appointment of Miss Upleger this question can probably be more satisfactorily adjusted. In addition to the regular class work the librarian devoted considerable time to the selection of the four students to study library science in the United States under the provisions of Act No. 2746.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1918 the Philippine Journal of Science was issued as usual in four sections. Each section consists of six numbers and is separately paged and indexed. The following table shows the number of pages, plates, and text figures contained in each section of Volume XIII:

	Section A.	Section B.	Section C.	Section D.
Pages	369	347	397	394
Plates	27	18	6	15
Text figures	62	10	6	24

The following papers were published in Volume XIII (1918) of the Philippine Journal of Science:

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1918

Heise, George W., and Behrman, A. S. Water analysis in the field.
Behrman, A. S. Two field methods for the determination of the total hardness of water.
Witt, J. C. Some generalizations on the influence of substances on cement and concrete.

No. 2, March, 1918

Wright, J. R., and Heise, G. W. The radium content of water from the China Sea.
Witt, J. C. Methods of burning pottery in the vicinity of Manila and their influence on the quality of the product.
Cocannouer, Joseph A. Tests of some imported garden legumes.
Reviews.

No. 3, May, 1918

Ycasiano, Francisco R., and Valencia, Felix V. Practical operation of a producer-gas power plant.
Mirasol, José y Jison. Fertilizer experiments with sugar cane.

No. 4, July, 1918

Witt, J. C., and Reyes, F. D. The solubility of Portland cement and its relation to theories of hydration.
Reinking, Otto A. Philippine economic-plant diseases.

No. 5, September, 1918

Reinking, Otto A. Philippine economic-plant diseases (concluded).

No. 6, November, 1918

Valencia, F. V. Mechanical extraction of coir.
King, Albert E. W. The mechanical properties of Philippine coir and coir cordage compared with abacá (Manila hemp).
Ycasiano, F. R. A recalculation of certain data on steaming tests of Philippine coals.
Concepcion, Isabelo. Analysis of normal Filipino urine.
Review.
Index.

SECTION B. TROPICAL MEDICINE

No. 1, January, 1918

Barber, Marshall A. Some observations and experiments on Malayan Anopheles with special reference to the transmission of malaria. I, Experimental and natural infection of insects with malaria, with some notes on the morphology and biology of certain types of Anopheles rossi.

De la Paz, D., and Montenegro, R. Does the irritant action of emetine hydrochloride extend to the kidney?

Reviews.

Proceedings of the Manila Medical Society.

No. 2, March, 1918

Maul, Herman G. Bone and joint lesions of yaws with X-ray findings in twenty cases.

Haughwout, Frank G. Infections with Coccidium and Isospora in animals in the Philippine Islands and their possible clinical significance.

Boynton, William Hutchins. Experiments on the treatment of rinderpest with various drugs.

Proceedings of the Manila Medical Society.

No. 3, May, 1918

Boynton, William Hutchins. Preliminary report on the virulence of certain body organs in rinderpest.

Boynton, William Hutchins. Note on the use of organ extracts in place of virulent blood in immunization and hyperimmunization against rinderpest.

Monserrat, Carlos. Comparative study on natural hemolysins in inactivated human and monkeys' serum.

No. 4, July, 1918

Wade, H. W. Studies on cryptoplasmic infection. I, Development of a Cryptococcus in cultures from an unclassified chronic Philippine ulcer.

Guerrero, L. E., Domingo, E., and Argüelles, M. Further observations on the treatment of yaws with Castellani's mixture.

Ruth, Edward S. Reconstruction of two sets of duck twins, with special reference to the early embryonic development of the vascular system.

Reviews.

Proceedings of the Manila Medical Society.

No. 5, September, 1918

Haughwout, Frank G. The tissue-invasive powers of the flagellated and ciliated protozoa with especial reference to Trichomonas intestinalis. A critical review.

Lantin, Pedro T. Preliminary report on various methods of serum application in bacillary dysentery.

Wade, H. W. Note on the portal of entry in experimental chronic pulmonary (systemic) blastomycosis. Studies in fungus infection II.

Pañganiban, C. S., and Schöbl, Otto. Preservation of cholera stool specimens for delayed bacteriologic examination.

Reviews.

Proceedings of the Manila Medical Society.

No. 6, November, 1918

Haughwout, Frank G. Endemic malaria in the Philippine Islands as a military problem.
Ruth, Edward S. A study of the calcium glands in the common Philippine house lizard.
Ruth, Edward S. A study of one hundred thirty-five human embryos and fœtuses collected in the Philippine Islands.
Reviews.
Proceedings of the Manila Medical Society.
Index.

SECTION C. BOTANY

No. 1, January, 1918

Merrill, E. D. New or noteworthy Philippine plants, XIII.

No. 2, March, 1918

Merrill, E. D. New species of Bornean plants.

No. 3, May, 1918

Merrill, E. D. Notes on the flora of Loh Fau Mountain, Kwangtung Province, China.
Foxworthy, F. W. Philippine Dipterocarpaceæ, II.

No. 4, July, 1918

Brotherus, V. F. Contributions to the bryological flora of the Philippines, V.
Brown, W. H. The fungi cultivated by termites in the vicinity of Manila and Los Baños.
Yates, H. S. Fungi from British North Borneo.
Shaw, W. R. Some microtechnical methods and devices.

No. 5, September, 1918

Merrill, E. D. New or noteworthy Philippine plants, XIV.

No. 6, November, 1918

Swingle, Walter T. Merrillia, a new genus of the tribe Citreae from the Malay Peninsula.
Brown, William H. The theory of limiting factors.
Brown, William H., and Trelease, Sam F. Alternate shrinkage and elongation of growing stems of Cestrum nocturnum.
Yates, Harry S. Some recently collected Philippine fungi, II.
Index.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1918

McGregor, Richard C. New or noteworthy Philippine birds, II.
Funkhouser, W. D. Notes on the Philippine Membracidæ.

No. 2, March, 1918

Bergroth, E. Studies in Philippine Heteroptera, I.

No. 3, May, 1918

Bergroth, E. Studies in Philippine Heteroptera, I (concluded).

No. 4, July, 1918

Cockerell, T. D. A. The megachilid bees of the Philippine Islands.
Robinson, Elizabeth. Descriptions and records of Philippine Coccidæ.
Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part V.
Review.

No. 5, September, 1918

Haughwout, Frank G. The Protozoa of Manila and the vicinity: I.
Pettey, F. W. Two new species of Sciara from the Philippines.
Wharton, Lawrence D. Notes on nematode parasites of Philippine birds. Tetrameres fissispina (Diesing, 1860) in Philippine chickens.
Zimmer, John T. A few rare birds from Luzon and Mindoro.
Taylor, Edward H. Reptiles of Sulu Archipelago.
Schultze, W. Fifth contribution to the Coleoptera fauna of the Philippines.

No. 6, November, 1918

Felt, E. P. New Philippine gall midges, with a key to the Itonididæ.
Zimmer, John T. Some notes on the birds of southern Palawan and adjacent islands.
Taylor, Edward H. Two new snakes of the genus Holarchus with descriptions of other Philippine species.
Schultze, W. Sixth contribution to the Coleoptera fauna of the Philippines.

The following miscellaneous publications have been issued:

The Sixteenth Annual Report of the Director of the Bureau of Science. (Printed in English and in Spanish.)
Species Blancoanae: A Critical Revision of the Species of Plants Described by Blanco and by Llanos.
Philippine Water Supplies.
The Philippine Journal of Science and Other Publications of the Bureau of Science.

A very comprehensive manuscript entitled Vegetation of Philippine Mountains has been forwarded to the Bureau of Printing and is now partly in galley proof.

Late in the year the following manuscripts were sent to the printer for publication: Amphibia of the Philippines, Lizards of the Philippines, and Index to the Genera of Birds.

The press bulletins issued during the year are as follows:

No. 85. Copra and other coconut products. (Printed in English and in Spanish, February, 1918.)
No. 86. Philippine fuels. (Printed in English and in Spanish, February, 1918.)
No. 87. The Philippine Bureau of Science. (Printed in English and in Spanish, May, 1918.)
No. 88. Sugar improvements. (Issued in English and in Spanish, March 12, 1918.)
No. 89. Pulverized coal and its advantages as a fuel in the Philippine Islands. (Printed in English, December, 1918.)
No. 90. Peanuts as a balanced diet. (Issued in English and in Spanish, November 13, 1918.)

No. 91. Philippine materials are suited to the manufacture of glass, caustic soda, etc. (Issued in English, December 20, 1918.)

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1917	1918
Paid subscriptions	415	426
Exchanges	485	505
Reviews	61	60
Free	40	49
Total mailing list	1,001	1,040

Several complete sets of the Philippine Journal of Science were sold during the year. Due to the work of conservation in the United States a few exchanges sent notice that their publications could no longer be sent. The reorganization of the Philippine Journal of Science for the year 1919 is described on p. 14.

POWER PLANT

The personnel, functions, and installations of the central power plant remain unchanged.

During 1917 the Bureau of Science experimented with, and recommended the use of, copra cake as fuel under boilers. Since August, 1918, this fuel has been used in the Bureau of Science power plant. This was not done sooner due to the difficulty of securing a regular supply, and even now with an Insular Government contract deliveries are made with much irregularity and coal frequently has to be used; but the use of copra cake under the boilers has effected a considerable saving. The electric current generated and delivered at the switchboard was 209,378 kilowatt hours at an average cost per kilowatt hour of ₱0.1093 as compared with ₱0.0803 for 1917. The producer-gas plant and gas engine have been running as nicely as ever with various kinds of coal, which fact is corroborative evidence of the reliability of this type of prime mover when maintained with care. The total amount of steam generated in the boilers was 5,646,705 kilograms at an average cost per kilogram of ₱0.005210 as compared with 0.003811 in 1917. Though there was a slight increase over last year in the cost of electric current per kilowatt hour and of steam per kilogram, yet, considering the present price of fuel, it was very low for the reason that as little coal as possible was used except in the producer plant. The low cost of the electric current is due primarily to the general use of the producer-gas plant.

The total gas generated for laboratory purposes was 948,420 cubic feet (26,860 cubic meters). The dilution of the Mansfield gas-generating plant gas with producer gas continues satisfactory. The average cost of production of the gas as used in the laboratory was ₱2.68 per 1000 cubic feet, ₱0.0911 per cubic meter.

The regular repair and adjustment of engines, boilers, pumps, electric apparatus, and Bureau equipment generally have been continued.

CLERICAL DIVISION

Mr. G. M. de Ubago was appointed chief clerk on March 1, 1918, by promotion from the positions of assistant and acting chief clerk. There have been some reassignments in the clerical personnel, and several new clerks and junior stenographers have been appointed to fill positions left vacant by resignations. The clerical personnel of the Bureau of Science is now practically full and the work well organized. The filing, accounting, and property are competently and intelligently handled and kept up to date. Mr. Martinez, chief property officer, was detailed to, and worked successfully for, the Fourth Liberty Loan Campaign and Red Cross Drive in the Bureau of Science. In order to compensate for the high cost of living, the regulations with regard to the wages of laborers in the Bureau of Science have been revised, and a new schedule has been adopted.

The grounds of the Bureau of Science have been well maintained during the year, and the main entrance road has been repaired.

The new rabbit-breeding cages mentioned last year have been very satisfactory, and the breeding has proved successful. Five hundred forty-two rabbits were born during the year of which 60 per cent have been brought to maturity. Those that were lost died in an epidemic during a very short period. If epidemics can be prevented in the future it will be unnecessary to purchase any rabbits at all. Two hundred twenty-one guinea pigs were raised during the year, and a supply of monkeys adequate to the needs of the Bureau of Science has been kept on hand. Although difficult to capture, an effort is being made to secure 50 monkeys per month for four months for the military authorities in the United States. The usual efforts have been unsuccessful for, owing to the influenza, there is a shortage of rice harvesters, and people in the provinces will not spend their time catching monkeys. It is believed that the extra effort will be successful.

PHOTOGRAPHY

The photographer has been detailed to make still photographs and cinematograph films for the Council of National Defense, Red Cross, College of Liberal Arts, University of the Philippines, Philippine Guard, etc. The usual amount of work for the Philippine General Hospital and the College of Medicine and Surgery of the University of the Philippines, and for other Government bureaus and offices, as well as for the Bureau of Science, has been completed. Mounted plain and colored lantern slides, prints, etc., have been made. A record of the photographic work performed is as follows:

Negative plates:	
5 by 7	703
8 by 10	53
Prints:	
5 by 7 (including 703 for the album)	8,592
8 by 10 (including 53 for the album)	818
Miscellaneous sizes	1,113
Direct enlargements	218
One album, containing 5 by 7 and 8 by 10	500
Developing:	
Plates, 4 by 5	83
Plates, 5 by 7	180
Plates, 8 by 10	4
Films, rolls (exposures)	30
Lantern slides:	
Colored	446
Uncolored	103
Transparencies, colored	16
Cinematograph film:	
Positive made, feet	2,150
Negative made, feet	395
Negative developed, feet	1,000

AQUARIUM

The aquarium of the Bureau of Science has continued to be much appreciated. It is clearly one of the most attractive features of Manila and is largely patronized by visitors in the city. During the year seven trips were made by Mr. Taylor, fish expert, or by the fish collector, to bring in new specimens. Many new, interesting, and beautiful specimens were added to the collection. I have continued to admit students and teachers of schools by special arrangement. The earnings of the aquarium were slightly greater than last year. In addition there were over 2,600 free admissions granted to schools.

RECOMMENDATIONS

The Bureau of Science is an efficient working organization and should be maintained so. To do this, as pointed out under the heading "Technical and Scientific Employees" on page 30, the Bureau must have efficient technical personnel; and, in order to retain that which it now has, and to secure additional men, recognition must be given in the higher positions. The Bureau of Science needs additional specialists in all its branches, especially in geology and industrial chemistry, to care for the rapidly developing mineral and economic industries. Without the employment of these there is grave danger that the development by the Government of such industries in the Philippine Islands will be discredited if not an entire failure. Much important constructive work in the Bureau of Science that should have been done has remained undone for lack of personnel, and there is the keenest need for extending economic research in every line.

With regard to the specific needs of the Bureau of Science, many of those that I have pointed out in former reports have not yet been realized, but the necessity is as keen as ever. I desire especially to call attention to my former requests for funds for a commercial marine and fresh-water products (fisheries) laboratory, survey, and hatchery; the appointment of an entomologist to carry on work involving the coöperation between bacteriologists, marine biologists, and others; the technical education of Filipinos in the United States; the utilization of powdered coal for fuel; the extension of the work of the Iloilo sugar laboratory; additional chemists and pharmacists for the investigation of promising medicinal and poisonous plants that have not as yet been investigated; a field survey of Philippine water supplies; a soil survey; enlargement of the plant for the preparation of extract of tikitiki for the treatment of infantile beriberi; investigation of the subject of animal diseases and insects injurious to agricultural products; the provision of demonstrators for propaganda work; etc. There is a wealth in the Philippine Islands that remains untouched due primarily to inadequate investigation. Unless work along the lines indicated is done much valuable work already completed by the Bureau will become ineffective. Successful economic development of the Philippines must be preceded by adequate research, and economic independence must precede successful political independence.

Tables showing the routine work performed and supplies manufactured and disposed of during the calendar year 1918 by the Bureau of Science, and a financial statement showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted,

Alvin J. Cox

Director, Bureau of Science.

To the Honorable
The SECRETARY OF AGRICULTURE AND NATURAL RESOURCES.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1918, as compared with the fiscal year 1917, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
General, inorganic, and physical chemistry:						
Metals and alloys	34	51	29	45	166.00	1,009.95
Rocks, minerals, natural pigments, and similar substances	5	9	5	8	39.00	86.00
Clays, shales, limestones, limes, wall plasters, cement, and slags	14	12	11	11	115.00	74.00
Fertilizers	26	10	24	9	221.00	80.00
Soils and similar substances	135	22	96	11	570.00	375.00
Coal analyses	29	33	23	33	405.00	1,000.00
Calorimetric tests of fuels	13	33	12	33	240.00	660.00
Paints and varnishes	4	2	4	2	96.50	20.00
Waters	232	158	21	12	388.00	391.00
Crude chemical and miscellaneous analyses	12	119	9	110	123.00	271.70
Standard solutions (in liters)	244	214	49	62	176.00	225.77
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	4	139	3	138	11.00	114.00
Cements	5,687	4,999	5,687	4,999	6,881.55	5,211.60
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	310	68	310	68	485.65	215.65
Standardization of road materials	33	3	30	3	170.00	12.00
Standardization of units of measure—						
Lengths	-----	72	-----	72	-----	7.20
Capacities	674	820	674	820	282.70	82.00
Weights	104	1,789	104	1,789	56.60	260.20
Miscellaneous	42	48	40	43	212.60	231.83
Total	7,602	8,601	7,131	8,268	10,639.70	10,327.90

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Organic chemistry:						
Urines, clinical and toxicological analyses	292	390	164	259	690.00	819.84
Essential oils and essences	12	9	12	9	109.00	58.50
Petroleum and products, copra, and similar materials	164	460	148	453	757.50	2,011.50
Linseed and castor oils	16	16	5	11	63.00	133.00
Gums, resins, and similar materials	9	1	9	1	86.00	10.00
Paper and similar materials	99	3	-----	-----	-----	-----
Gastric juice, clinical examinations	3	1	-----	-----	-----	-----
Foods and alcohols and beverages	736	813	186	171	859.00	786.35
Food preservatives and coloring matter	144	171	16	15	106.00	80.00
Medicines and similar articles	177	66	22	28	350.00	283.00
Miscellaneous chemical analyses and examinations	67	81	61	42	258.00	377.40
Total	1,719	2,011	623	989	3,278.50	4,559.59
Mines:						
Assays	386	253	383	253	1,308.85	1,353.67
Biological laboratory:						
Fæces	161,949	149,890	320	417	832.00	1,472.30
Sputum	822	887	78	72	177.00	204.38
Blood	92	67	63	54	314.00	291.34
Cultures	10	9	10	9	25.00	41.67
Widal tests	366	1,550	8	4	18.00	12.00
Wassermann tests	778	497	331	360	3,310.00	3,208.00
Leprosy	888	338		8	3.00	23.00
Urines	-----	37	-----		-----	117.00
Gonococci	16,715	13,888	30	1	90.00	139.00
Waters	2,319	3,156	-----	8	-----	152.00
Histological examinations	11	11	6	7	60.00	70.00
Rabies	3	3	-----	-----	-----	-----
Rats for plague	113,799	90,008	-----	-----	-----	-----
Miscellaneous biological examinations	7,110	1,938	5,104	24	143.20	154.50
Total	304,862	262,279	5,951	1,046	4,972.20	5,885.19

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Subdivision of the Bureau of Science.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Serum section of the biological laboratory:						
Vaccine virus (doses)	1,338,469	4,589,358	1,338,469	4,589,358	14,296.18	47,934.72
Mallein (doses)	308	188	308	188	308.00	188.00
Miscellaneous sera and preparations (cubic centimeters)	2,523,810	3,309,706	2,523,810	3,309,706	9,941.62	13,621.17
Total	3,862,587	7,899,252	3,862,587	7,899,252	24,545.80	61,743,89
Miscellaneous:						
Photographs	9,382	13,033	4,298	10,954	1,772.95	3,710.82
Natural-history specimens	19	32	19	31	488.77	276.40
Shop work	260	174	79	23	164.48	372.18
Miscellaneous work	33	----------	11	----------	5,619.68	6,602.20
Supplies	8,198	4,918	8,198	4,869	2,841.01	8,666.00
Sales of publications	----------	----------	----------	----------	4,037.50	5,194.48
Refunded, work not done, etc. (deducted)	----------	----------	----------	----------	(250.07)	(280.00)
Power, gas, etc	----------	----------	----------	----------	22,036.92	28,163.24
Total	17,892	18,157	12,605	15,877	36,711.24	52,705.32
Grand total	4,195,048	8,190,553	3,889,280	7,925,685	81.456.29	136.575.56

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1918, as compared with the fiscal year 1917, by number or quantity and by value, arranged with reference to Government and other patronage.*

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Agriculture:						
Soils and similar substances	27					
Crude chemical and miscellaneous analyses		9				
Foods and alcohols and beverages	24	63				
Miscellaneous chemical analyses and examinations	2	4				
Shop work	2		2		5.50	
Total	55	76	2		5.50	
Bureau of Coast and Geodetic Survey:						
Vaccine virus		100		100		1.00
Bureau of Commerce and Industry:						
Fæces		2				
Sputum		1				
Photographic work		180		180		29.23
Total		183		180		29.23
Bureau of Customs:						
Metals and alloys	1	1				
Foods and alcohols and beverages	10	1				
Food preservatives and coloring matter	4					
Waters, biological	21	1				
Petroleum and products, copra, and similar materials	11	2				
Miscellaneous, inorganic	1	2				
Linseed and castor oils		1				
Medicines and similar articles	6	3				
Assays	3					
Fæces	2					
Sputum	1					
Photographic work		30		30		6.00
Total	60	41		30		6.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Civil Service:						
Photographic work	120		120		19.55	
Council of National Defense:						
Photographic work		2,852		2.852		970.00
Bureau of Education:						
Soils and similar substances	5					
Miscellaneous	1	3				
Photographic work	104	28	104	28	77.34	7.00
Total	110	31	104	28	77.34	7.00
Executive Bureau:						
Photographic work	8	11	8	11	2.20	14.60
Supplies		2		2		4.80
Total	8	13	8	13	2.20	19.40
Department of Finance:						
Metals and alloys		1				
Bureau of Forestry:						
Fertilizers	1	1				
Photographic work	63	71	63	71	15.75	20.80
Supplies		118		118		33.16
Total	64	190	63	189	15.75	53.96
Philippine Health Service:						
Waters, chemical	1	10				
Waters, biological	1,927	3,099				
Crude chemical and miscellaneous analyses		88		88		35.20
Urines, clinical and toxicological analyses	111	104				
Petroleum and products, copra, and similar materials		4				
Linseed and castor oils	5	3				
Gastric juice, clinical examinations	2	1				
Foods and alcohols and beverages	498	557				
Food preservatives and coloring matter	124	156				
Medicines and similar articles	146	11				
Miscellaneous chemical analyses and examinations	10	11	10	11	80.00	28.40
Fæces	31,736	53,591				
Sputum	732	808				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Philippine Health Service—Continued.						
Blood	27	11				
Widal tests	353	1,492				
Wassermann tests	30	16				
Leprosy	887	323				
Urines		5				
Gonococci	16,685	13,837				
Histological examinations	2	2				
Rabies	3	3				
Rats or plague	113,783	90,008				
Miscellaneous biological work and examinations	1,981	1,897				
Vaccine virus	1,261,793	4,412,152	1,261,793	4,412,152	12,617.93	44,126.20
Miscellaneous sera and preparations	1,027,071	1,748,506	1,027,071	1,748,506	2,082.64	4,619.67
Photographic work	272	290	272	290	280.40	115.10
Shop work		2		2		75.70
Supplies	2,347	1,697	2,347	1,697	56.90	89.60
Total	2,460,526	6,328,684	2,291,493	6,162,746	15,117.87	49,089.87
Bureau of Internal Revenue:						
Standardization of weights	3		3		6.50	
Lengths		7		7		0.70
Capacities		5		5		0.50
Weights		28		28		2.80
Foods and alcohols and beverages	12		12		50.00	
Medicines and similar articles		1				
Photographic work	5		5		1.00	
Total	20	41	20	40	57.50	4.00
Bureau of Justice:						
Photographic work		1		1		0.20
Urines, clinical and toxicological analyses	4		4		180.00	
Medicines and similar articles	18	19	18	19	310.00	185.00
Blood	1		1		75.00	
Total	23	20	23	20	565.00	185.20
Philippine Assembly:						
Photographs	11		11		37.75	

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Lands:						
Soils and similar substances	1					
Cements	1		1		2.00	
Standardization of road materials	3					
Miscellaneous	5		5		2.00	
Miscellaneous chemical analyses and examinations	2					
Total	12		6		4.00	
Board of Pharmaceutical Examiners and Inspectors:						
Medicines and similar articles		21				
Philippine Library and Museum:						
Supplies		2		2		24.00
Photographic work	26		26		16.00	
Total	26	2	26	2	16.00	24.00
Philippine National Guard:						
Foods and alcohols and beverages		1				
Fæces		1		1		5.33
Wassermann tests		54		54		148.00
Vaccine virus	650	700	650	700	6.50	7.00
Miscellaneous sera and preparations		102		102		14.95
Shop work		2		2		138.56
Total	650	860	650	859	6.50	313.84
Philippine Constabulary:						
Urines, clinical and toxicological analyses	2	1				
Blood	1					
Miscellaneous biological work and examinations	4	13	4		40.00	
Miscellaneous chemical analyses and examinations		6		6		24.00
Miscellaneous, inorganic		3		3		15.00
Photographic work		900		900		250.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	**1918**	**1917**	**1918**	**1917**	**1918**
Philippine Constabulary—Continued.						
Vaccine virus	1,500	6,950	1,500	6,950	15.00	69.50
Miscellaneous sera and preparations	60	4,875	60	4,875	24.00	120.55
Total	1,567	12,748	1,564	12,734	79.00	479.05
Bureau of Posts:						
Coal analysis	1	----------	----------	----------	----------	----------
Photographic work	----------	1	----------	1	----------	8.00
Total	1	1	----------	1	----------	8.00
Bureau of Printing:						
Paper and similar materials	99	3	----------	----------	----------	----------
Bureau of Prisons:						
Urines, clinical and toxicological analyses	2	----------	----------	----------	----------	----------
Gastric juice	1	----------	----------	----------	----------	----------
Foods and alcohols and beverages	1	----------	----------	----------	----------	----------
Medicines and similar articles	2	----------	----------	----------	----------	----------
Fæces	124,695	92,219	----------	----------	----------	----------
Sputum	----------	1	----------	----------	----------	----------
Widal tests	5	54	----------	----------	----------	----------
Wassermann tests	417	121	----------	----------	----------	----------
Leprosy	----------	7	----------	----------	----------	----------
Rats for plague	7	4	----------	----------	----------	----------
Histological examinations	3	2	----------	----------	----------	----------
iscellaneous sera and preparations	1	----------	1	----------	6.67	----------
Waters, biological	----------	42	----------	----------	----------	----------
iscellaneous biological work and examinations	8	----------	----------	----------	----------	----------
Supplies	----------	36	----------	36	----------	1.50
Total	125,142	92,486	1	36	6.67	1.50
Bureau of Public Works:						
Standard solutions (in liters)	----------	8	----------	8	----------	11.00
Cements	520	111	520	111	993.50	211.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	195	9	195	9	170.00	63.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Public Works—Continued.						
Standardization of road materials	11	3	11	3	57.00	12.00
Paints and varnishes	1	1	1	1	36.00	15.00
Petroleum and products, copra, and similar materials	1					
Waters, chemical	77	133				
Waters, biological		4				
Photographic work	129		129		19.44	
Supplies	31		31		1.00	
Total	955	269	887	132	1,276.94	312.50
Bureau of Quarantine Service:						
Urines, clinical and toxicological analyses	1	6				
Fæces	4,789	3,104	21		63.00	
Sputum		1				
Rats for plague	9					
Vaccine virus	7,000	15,100	7,000	15,100	70.00	151.00
Total	11,799	18,211	7,021	15,100	133.00	151.00
Bureau of Science:						
Metals and alloys	2	2				
Rocks, minerals, natural pigments, and similar substances		1				
Clays, shales, limestones, limes, wall plasters, cements, and slags	3	1				
Fertilizers	1					
Coal analyses	5					
Calorimetric tests of fuels	1					
Soils and similar substances	6	11				
Crude chemical and miscellaneous analyses	3					
Standard solutions (in liters)	195	152				
Foods and alcohols and beverages	2					
Fæces	12	23				
Petroleum and products, copra, and similar materials	3	1				
Sputum	11	4				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Science—Cont.						
Urines, clinical and toxicological analyses	12	20				
Linseed and castor oils	5					
Blood	1	2				
Miscellaneous chemical analyses and examinations	2	33				
Waters, chemical	128					
Waters, biological	371					
Miscellaneous biological work and examinations	30					
Photographic work	5,083	2,079				
Natural-history specimens		1				
Shop work	181	151				
Supplies		49				
Total	6,056	2,530				
Bureau of Secret Service:						
Urines, clinical and toxicological analyses		2		2		28.50
Bureau of Supply:						
Metals and alloys	2	2				
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	1	1				
Cements	4,817	4,858	4,817	4,858	4,513.30	4,832.10
Paints and varnishes	1		1		6.50	
Standardization of units of measure—						
Lengths		65		65		6.50
Capacities	615	815	615	815	221.70	81.50
Weights	101	1,710	101	1,710	50.10	153.70
Miscellaneous	4		4		3.80	
Petroleum and products, copra, and similar materials	1					
Linseed and castor oils	1	1				
Foods and alcohols and beverages	15	20				
Medicines and similar articles	1	2				
Miscellaneous chemical analyses and examinations	32	2	32		10.00	
Waters, chemical	5	3				

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Bureau of Supply—Cont.						
Miscellaneous biological work and examinations	9					
Vaccine virus	25,825	40,100	25,825	40,100	258.25	401.00
Miscellaneous sera and preparations	49,857	12,358	49,857	12,358	4,799.60	91.90
Supplies	280	1,667	280	1,667	72.10	722.30
Total	81,567	61,604	81,532	61,573	9,935.35	6,289.00
University of the Philippines:						
Vaccine virus	50	370	50	370	0.50	37.00
Fæces	416	534				
Miscellaneous sera and preparations	7	7,506	7	7,506	1.57	17.70
Photographic work	265	1,273	265	1,273	54.75	311.92
Shop work	5	1	5	1	24.73	4.00
Supplies	540	13	540	13	48.00	12.40
Total	1,283	9,697	867	9,163	129.55	383.02
City of Manila:						
Standard solutions (in liters)	46	51	46	51	160.00	199.27
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	24		24		12.50	
Miscellaneous chemical analyses and examinations	1	3	1	3	15.00	10.00
Miscellaneous biological work and examinations		2		2		5.50
Vaccine virus		300		300		3.00
Photographic work	1					
Miscellaneous sera and preparations	100,000	100,000	100,000	100,000	100.00	100.00
Total	100,072	100,356	100,071	100,356	287.50	317.77
Provinces and municipalities:						
Cements		11		11		51.00
Standardization of units of weight	24	6	24	6	24.00	9.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	1	1	1	1	30.00	10.00

Table II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Provinces and municipalities—Cont.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	65	37	65	37	223.15	79.65
Coal analyses	3		3		105.00	
Standardization of road materials	19		19		113.10	
Medicines and similar articles	3	5	3	5	30.00	50.00
Waters, chemical	4	3	4	3	70.00	130.00
Waters, biological		2				
Blood	1		1		75.00	
Vaccine virus	20,000		20,000		600.00	
Total	20,120	65	20,120	63	1,270.25	329.65
United States Army and Navy:						
Metals and alloys	1	12	1	12	4.00	72.00
Waters, chemical	9		9		190.00	
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		7		7		14.00
Cements	76	2	76	2	291.25	7.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	6	17	6	17	42.00	29.00
Crude chemical and miscellaneous analyses		7		7		108.50
Standardization of units of weight		1		1		20.00
Petroleum and products, copra, and similar materials	7	9	7	9	39.00	122.00
Linseed and castor oils	2	5	2	5	30.00	75.00
Foods and alcohols and beverages	8	10	8	10	80.00	84.00
Waters, biological		2		2		40.00
Vaccine virus	17,824	83,201	17,824	83,201	583.90	1,815.10
Mallein	306	188	306	188	306.00	188.00
Miscellaneous sera and preparations	319,743	515,175	319,743	515,175	844.50	1,690.33
Supplies	111	24	111	24	50.60	60.00
Total	338,093	598,660	338,093	598,660	2,461.25	4,325.43

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Miscellaneous:						
Metals and alloys	28	33	28	33	162.00	937.95
Clays, shales, limestones, limes, wall plasters, cements, and slags	10	10	10	10	85.00	64.00
Rocks, minerals, natural pigments, and similar substances	5	8	5	8	39.00	86.00
Fertilizers	24	9	24	9	221.00	80.00
Soils and similar substances	96	11	96	11	570.00	375.00
Coal analyses	20	33	20	33	300.00	1,000.00
Calorimetric tests of uels	12	33	12	33	240.00	660.00
Crude chemical and miscellaneous analyses	9	15	9	15	123.00	128.00
Paints and varnishes	2	1	2	1	54.00	5.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles	3	131	3	131	11.00	100.00
Standard solutions (in liters)	3	3	3	3	16.00	15.50
Cements	273	17	273	17	1,081.50	109.50
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	20	5	20	5	38.00	44.00
Standardization of units of weight	35	44	35	44	37.00	74.70
Miscellaneous inorganic analyses	31	40	31	40	206.80	216.83
Urines, clinical and toxicological analyses	160	257	160	257	510.00	791.34
Essential oils and essences	12	9	12	9	109.00	58.50
Petroleum and products, copra, and similar materials	141	444	141	444	718.50	1,889.50
Linseed and castor oils	3	6	3	6	33.00	58.00
Gums, resins, and similar materials	9	1	9	1	86.00	10.00
Foods and alcohols and beverages	166	161	166	161	729.00	702.35
Food preservatives and coloring matter	16	15	16	15	106.00	80.00
Medicines and similar articles	1	4	1	4	10.00	48.00

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of, etc.*—Continued.

Customer.	Samples or units.		Cash work.			
			Samples or units.		Pesos.	
	1917	1918	1917	1918	1917	1918
Miscellaneous—Cont.						
Miscellaneous chemical analyses and examinations	18	22	18	22	153.00	315.00
Assays	383	253	383	253	1,308.85	1,353.67
Waters, chemical	8		8	9	128.00	261.00
Waters, biological	---	6	---	6	---	112.00
Fæces	299	416	299	416	769.00	1,466.97
Sputum	78	72	78	72	177.00	204.38
Blood	61	54	61	54	164.00	291.34
Cultures	10	9	10	9	25.00	41.67
Widal tests	8	4	8	4	18.00	12.00
Wassermann tests	331	306	331	306	3,310.00	3,060.00
Leprosy	1	8	1	8	3.00	23.00
Urines, biological	---	32	---	32	---	117.00
Gonococci	30	51	30	51	90.00	139.00
Histological examinations	6	7	6	7	60.00	70.00
Mallein	2	---	2	---	2.00	---
Miscellaneous biological work and examinations	5,100	22	5,100	22	103.20	149.00
Vaccine virus	3,827	30,385	3,827	30,385	144.10	1,323.92
Miscellaneous sera and preparations	1,027,071	921,184	1,027,071	921,184	2,082.64	6,966.07
Photographic work	3,295	5,317	3,295	5,317	1,248.77	1,977.97
Natural-history specimens	19	31	19	31	488.77	276.40
Shop work	72	18	72	18	134.25	153.92
Miscellaneous work	11	---	11	---	5,619.68	6,602.20
Supplies	4,889	1,310	4,889	1,310	2,612.41	7,718.24
Sales of publications	---	---	---	---	4,037.50	5,194.48
Refunded, work not done, etc. (deducted)	---	---	---	---	(250.07)	(280.00)
Power, gas, etc	---	---	---	---	22,036.92	28,163.24
Total	1,046,598	960,806	1,046,598	960,806	49,951.82	73,246.64
Grand total	4,195,048	8,190,553	3,889,280	7,925,685	81,456.29	136,575.56

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1918 (January 1 to December 31, 1918) as compared with the fiscal years 1916 and 1917.*

EXPENDITURES.

Item.	Fiscal year.		
	1916	1917	1918
Salaries and wages, etc.:	*Pesos.*	*Pesos.*	*Pesos.*
Salaries and wages, including accrued leave	231,180.22	218,161.41	213,396.23
Travel expenses of personnel	12,964.40	10,772.71	8,991.08
Total	244,144.62	228,934.12	222,387.31
Apparatus, supplies, etc.:			
Consumption of supplies and materials, including subscriptions	72,929.96	88,028.54	94,452.90
Apparatus and equipment, including books	21,429.44	13,449.10	19,761.31
Total	94,359.40	101,477.64	114,214.21
Miscellaneous:			
Rental of buildings	481.50	360.00	
Postal, telegraph, telephone, and cable service	3,990.65	3,944.89	4,000.00
Freight, express, and delivery service	1,725.92	1,157.99	1,278.38
Printing and binding reports, documents, and publications	21,238.19	25,000.00	34,725.00
Illumination and power service	1,628.53	1,633.66	1,800.00
Miscellaneous service	4,520.06	1,305.07	4,736.69
Maintenance and repair of furniture and equipment	4,200.00	4,200.00	1,752.27
Total	37,784.85	37,601.61	48,292.34
Grand total	376,288.87	368,013.37	384,893,86

INCOME.

Receipts from operation	81,335.08	81,456.29	130,054.47
Prior year income	647.89		
Sales of supplies			26.35
Sales of fixed assets	1,575.70	1,524.42	6,244.67
Other		1,688.74	250.07
Total	83,558.67	84,669.45	136,575.56
Appropriation account:			
Appropriated	371,976.00	381,810.00	433,120.00
Allotted by the Emergency Board	25,000.00	28,000.00	
Appropriated by Deficiency Act No. 2783			20,725.00
Brought forward for equipment	20,039.31	13,609.87	10,160.77
Total	417,015.31	423,419.87	464,005.77

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1918, etc.*—Continued.

MISCELLANEOUS ACCOUNTS (1918).

Item.	Available.	Expended.	Balance.
	Pesos.	*Pesos.*	*Pesos.*
Tikitiki distribution, Acts Nos. 2376 and 2714	9,336.01	5,990.87	3,345.14
Improvement of the Aquarium, Act No. 2494	77.15		77.15
Replacement fund (Iloilo fire)	2,246.20	1,232.30	1,013.90
Serum Laboratory improvement, Act No. 2704	996.07	996.07	
Publicity service for the Philippine Food Commission (allotted by the Emergency Board)	2,238.80	500.00	1,738.80
Preparation and free distribution of antityphoid vaccine, Act No. 2743	5,000.00	1,077.05	3,922.95
Total	19,894.23	9,796.29	10,097.94

INDEX

Appreciation of Bureau of Science publications, 15.
Aquarium, 60.
Biological laboratory, division of, 32.
Botany, section of, 35.
Carnival exhibit, 26.
Chemical laboratory, 40; division of general, inorganic, and physical chemistry, 41; investigation, 44; division of organic chemistry, 46.
Clerical division, 59.
Coöperation and publicity, 16.
Entomology, section of, 39.
Fisheries, section of, 38.
Foods, 29.
Geographical names, 25.
Government motor transportation, standardization of, 24.
Library, 52.
Manufacture of tikitiki and autolyzed yeast extracts, 18.
Ornithology and taxidermy, section of, 39.
Philippine Islands Medical Association and IV Asamblea Regional de Médicos y Farmacéuticos de Filipinas, 18.
Philippine Journal of Science and other publications, 53.
Philippine Veterinary Medical Association Congress, 22.
Philippines and the war, the, 12.
Photography, 60.
Power plant, 58.
Preparation and free distribution of antityphoid vaccine, 24.
Proposed new serum laboratory, 22.
Pulverized coal, 29.
Recommendations, 61.
Reörganization of the Philippine Journal of Science, 14.
Sera and vaccines, section of, 34.
Supplies, standardization of, 25.
Table, comparative, of routine work performed and supplies manufactured and disposed of during the fiscal year 1918, as compared with the fiscal year 1917, by number or quantity and by value, arranged by subdivisions of the Bureau of Science, 63.
Table, comparative, of routine work performed and supplies manufactured and disposed of during the fiscal year 1918, as compared with the fiscal year 1917, by number or quantity and by value, arranged with reference to Government and other patronage, 66.
Table, comparative, showing expenditures and income during the fiscal year 1918 (January 1 to December 31, 1918) as compared with the fiscal years 1916 and 1917, 77.
Technical and scientific employees, 30.
Technical education of Filipinos in the United States, 31.
War work, 10.

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